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NATIONAL DAM SAFETY PROGRAM. INDIAN CREEK MINE DAMS (MO 30717 A--ETC(U)
FEB 80 K B KING, J H GRAY, D E WESTCOTT DACW43-79-C-0037

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1 OF 2
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AD A106468

INDIAN CREEK MINE DAMS
WASHINGTON COUNTY, MISSOURI
MO 30717 & 31036

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
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St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

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Washington County, Missouri Lower (MO 30717)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

LMSED-P

SUBJECT: Indian Creek Mine Dams, Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Indian Creek Mine Lower Dam (MO 30717) and Upper Dam (MO 31036).

It was prepared under the National Program of Inspection of Non-Federal Dams.

These dams have been classified as unsafe, emergency by the St. Louis District based on the following: Piping of tailings was evident along most of the toe of the enlarged section of the lower dam (MO 30717) and along the toe of a majority of the upper dam (MO 31036). Increased water levels are considered to increase piping which could lead to dam failure.

For Phase I reports, the extent of the downstream damage zone has been determined assuming that all materials contained by the tailings dam are in a liquid state.

SUBMITTED BY: SIGNED — 10 JUN 1980
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 10 JUN 1980
Colonel, CE, District Engineer — Date

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INDIAN CREEK MINE DAMS
WASHINGTON COUNTY, MISSOURI

MISSOURI INVENTORY NOS. 30717 (LOWER DAM)
AND 31036 (UPPER DAM)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY

INTERNATIONAL ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
SAN FRANCISCO, CALIFORNIA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

FEBRUARY 1980

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dams	Indian Creek Mine Dams
State	Missouri
County	Washington
Stream	Unnamed Tributary to Goose Creek
Dates of Inspection	17 April 1979 - Lower Dam (30717)
	23 August 1979 - Upper Dam (31036)

The Indian Creek Mine Dams were inspected by two civil engineers and an engineering geologist from International Engineering Company, Inc., of San Francisco, California. The dams are owned by St. Joe Minerals Corporation of Viburnum, Missouri. The purpose of the inspections was to assess the general condition of the dams with respect to safety. The assessments were based upon an evaluation of the available data, visual inspections, and an evaluation of the hydrology and hydraulics of the sites to determine if the dams pose hazards to human life or property. The purpose of the dams is to impound lead tailings and water.

The Indian Creek Mine Dams were inspected using the "Recommended Guidelines for Safety Inspection of Dams" furnished by the Department of the Army, Office of the Chief of Engineers. Based on these Guidelines, these dams are classified as intermediate size. The St. Louis District Corps of Engineers has classified these dams as having a high downstream hazard potential to indicate that failure of these dams could threaten life and property. The estimated damage zone provided by the St. Louis District Corps of Engineers extends approximately eight miles downstream of the Lower Dam (30717). There are eight dwellings, one church, and two road crossings within this damage zone.

The results of the inspection and evaluation of the Lower Dam (30717) indicate that the combined capacity of the spillway and the 12-inch diameter outlet pipe, and the storage capacity of the dam meet the criteria given in the Guidelines for a dam of the size and hazard potential of the Indian Creek Mine Lower Dam. As an intermediate size dam with a high hazard potential, the Guidelines specify that the discharge capacity and/or storage capacity should be capable of safely handling the Probable Maximum Flood (PMF) without overtopping the crest. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. It is noted that although the hydrologic analysis shows the Lower Dam capable of passing the PMF without overtopping, the dam could become unstable if a sufficient depth of water is impounded to accelerate piping, and high velocities at the spillway section would cause significant erosion of the spillway channel.

It was calculated that the spillway and outlet could pass a 100-year flood (a flood having a one percent chance of being equalled or exceeded in any one year) without overtopping the dam, but not without significant erosion of the spillway. In addition, it was estimated that the spillway and outlet could not pass a 10-year flood (a flood having a ten percent chance of being equalled or exceeded in any one year) without significant erosion of the spillway. It was also estimated that the spillway and outlet could pass 3 percent of the PMF without significant erosion of the spillway. However, the spillway and outlet can not pass 50 percent of the PMF without significant erosion of the spillway. Erosion of the spillway channel will not endanger the embankment, since it is separated from the embankment at the right abutment and since it discharges into an adjacent drainage.

The results of the inspection and evaluation of the Upper Dam (31036) indicate an absence of facilities for discharging flood water, but its storage capacity meets the criteria given in the Guidelines for a dam of the size and hazard potential of the Indian Creek Mine Upper Dam. As an intermediate size dam with a high hazard potential, the Guidelines specify that the discharge capacity and/or storage capacity should be capable of safety handling the PMF without overtopping the crest. A 12-inch diameter outlet pipe functions as the spillway for the Upper Dam but has very little discharge capacity. It is noted that although the hydrologic analysis shows the Upper Dam capable of retaining the PMF without overtopping, the dam could become unstable if a sufficient depth of water is impounded to accelerate piping. It was also calculated that the impoundment can retain a 100-year flood (a flood having a one percent chance of being equalled or exceeded in any one year) without overtopping the dam.

There are deficiencies that affect the stability of both dams and that should be corrected. Both tailings embankments and their foundations could be susceptible to liquefaction under earthquake loadings. Seepage and stability analyses should be made to determine the safe maximum level of water at the Lower Dam for normal operation and for flood conditions. The analyses should lead to specific remedial work that would control seepage and piping of tailings through the dam. The same analyses should be done to determine what level of water can be safely impounded by the Upper Dam and whether or not construction of an overflow structure such as an open channel spillway would be required to maintain that level during the PMF. This overflow structure, if required, should have erosion protection adequate to withstand the peak discharge velocity resulting from the PMF without significant erosion of the spillway or embankment. It should be maintained as the dam is raised and should be modified so that it is always capable of passing the PMF while maintaining a safe level of impounded water. Specific remedial work for the Upper Dam should also be addressed to controlling seepage and piping of tailings through the dam. Seepage accumulating at the toe of the Lower Dam should be drained, erosion gullies and scarps on the downstream slope of the Lower Dam and on the exterior and interior slopes of the enlarged section of the Upper Dam should be repaired, and erosion protection should be provided on the dam slopes subject to heavy runoff or wave action. Analyses and remedial work should be performed under the direction of a professional engineer experienced in the design and construction of tailings dams.

Seepage and stability analyses of these dams are not available. These studies should be performed by a professional engineer experienced in the design and construction of tailings dams and should be made a matter of record. The necessary data for these analyses would be obtained from additional investigations. The investigations would consist of field exploration and soil sampling, laboratory testing programs, and engineering studies to evaluate the stability of the dams. Based on the results of these analyses, remedial measures may become necessary. Remedial work should be performed under the direction of an engineer experienced in the design and construction of tailings dams.

An inspection and maintenance program should be initiated for both dams. Periodic inspections should be made and documented by qualified personnel to observe the performance of the dams, spillway, and outlets.

It is recommended that the owner take action to correct the deficiencies described.

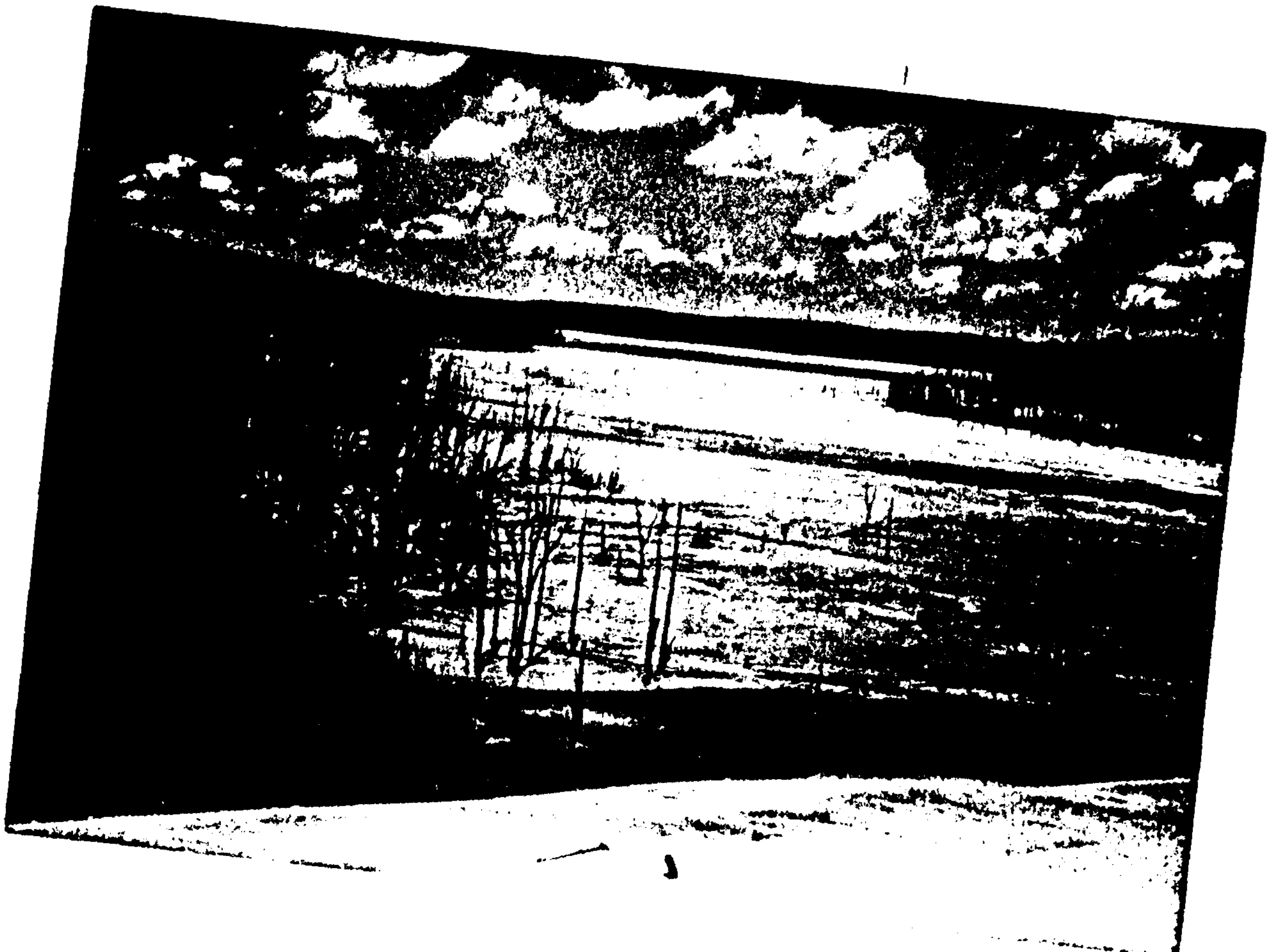
Kenneth B. King, P.E.

James H. Gray, P.E.

Donald E. Westcott

Stanley H. Kline, P.E.

OVERVIEW OF INDIAN CREEK MINE UPPER DAM - I.D. NO. 31036
FROM RIGHT ABUTMENT



OVERVIEW OF INDIAN CREEK MINE LOWER DAM - I.D. NO. 30717
FROM CREST OF UPPER DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
INDIAN CREEK MINE DAMS
I.D. NOS. 30717 (LOWER DAM)
AND 31036 (UPPER DAM)

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NATIONAL DAM SAFETY PROGRAM
INDIAN CREEK MINE DAMS - ID NOS. 30717 (LOWER DAM)
AND 31036 (UPPER DAM)

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspections of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that safety inspections of the Indian Creek Mine Dams be made and authorized International Engineering Company, Inc. to make the inspections.

b. Purpose of the Inspections. The purpose of the inspections was to assess the general condition of the dams with respect to safety, based on available data and on visual inspection, to determine if the dams pose hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dams were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These Guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dams and Appurtenances.

(1) Lower Dam (30717)

(a) The Indian Creek Mine Lower Dam is a cross-valley dam constructed with earthfill. Cycloned coarse lead tailings were used to raise the crest of the Lower Dam. The dam retains lead tailings, which consist of loose, saturated, fine sand and silt sized particles.

(b) The spillway is an uncontrolled open channel of trapezoidal cross section located in the right abutment. A 1400-foot long 12-inch diameter steel outlet pipe with a 19-inch diameter vertical riser section at the inlet also serves to discharge reservoir water.

(2) Upper Dam (31036)

(a) The Indian Creek Mine Upper Dam is a U-shaped valley-side dam constructed with cycloned coarse lead tailings. The dam retains lead tailings, which consist of loose, saturated, fine sand and silt, and it is built upon older lead tailings.

(b) The spillway is an uncontrolled 400-foot long 12-inch diameter steel outlet pipe with a 20-inch diameter vertical riser section at the inlet.

b. Location. Both dams are located in Washington County, Missouri, as shown on Plate 1. The Lower Dam (30717) and Upper Dam (31036) as shown on Plate 2 are located in Sections 33 and 34, Township 39 North, Range 1 East, and in Sections 3 and 4, Township 38 North, Range 1 East, respectively.

c. Size Classification.

(1) Lower Dam (30717): This dam is greater than 40 feet but less than 100 feet in height, and the impoundment storage is less than 50,000 acre-feet; therefore this dam is classified as an intermediate size dam in accordance with "Recommended Guidelines for Safety Inspections of Dams."

(2) Upper Dam (31036): This dam is greater than 40 feet but less than 100 feet in height, and the impoundment storage is less than 50,000 acre-feet; therefore this dam is also classified as an intermediate size dam.

d. Hazard Classification. These dams are classified as having a high hazard potential by the St. Louis District Corps of Engineers. The estimated damage zone, as provided by the St. Louis District, extends approximately eight miles downstream of the Lower Dam (30717). There are eight dwellings, one church, and two road crossings within this damage zone.

e. Ownership. These dams are owned by:

St. Joe Minerals Corporation
S. E. Missouri Mining and Milling Division
P.O. Box 500
Viburnum, MO 65566

f. Purpose of Dam.

(1) Lower Dam (30717): This dam impounds lead tailings. This dam also impounds water for use in lead ore refining activities. Deposition of tailings behind this dam ceased between 1973 and 1975.

(2) Upper Dam (31036): This dam impounds lead tailings resulting from ongoing lead ore refining activities. Deposition of tailings behind this dam is continuing.

g. Design and Construction History. The original earthfill dam at the Lower Dam site was constructed in 1953. Limited design data was available, and no construction records are known to exist. The dam was enlarged in 1956, 1957, 1959, and 1960; and, in 1971 through 1976 cycloned tailings were used to raise the crest immediately upstream from the original earthen dam. Tailings disposal activities at the Lower Dam ceased sometime between 1973 and 1975. No known failures have occurred at the site; however, a spillway washed out in a flood in 1959, which released some tailings but caused no structural damage to the dam. In 1960, the earthen dam was reported to have shown some signs of slumping, and it was buttressed with a crushed rock toe berm.

An intermediate dam about 3,000 feet upstream of the original earthen dam at the Lower Dam site was constructed as a cross-valley dam in 1961. Cycloned tailings were used to construct the dam, and between 1961 and 1971, the dam was raised several times using tailings.

Immediately upstream of the intermediate dam, the upper, valley-side dam (31036) is currently under construction. From 1977 to the present, cycloned lead tailings have been used to enlarge this dam which is built upon tailings impounded by the lower and intermediate dams. No design or construction records are known to exist for either the intermediate or the valley-side dam.

h. Normal Operating Procedures. Fine lead tailings are discharged into the Upper Dam (31036) impoundment in a slurry form from a cyclone operation on the embankment crest. Outflow from the Upper Dam passes through an uncontrolled, 12-inch diameter outlet pipe into an excavated drainage channel which drains into the Lower Dam (30717) pond. The Lower Dam is inactive in that tailings are no longer conveyed to the impoundment. Water from the pond is recycled back to the mill. Outflow from the Lower Dam passes through an uncontrolled, open channel spillway and a 12-inch diameter outlet pipe. Outlet structures for both dams do not require operation, and no operating records are known to exist.

1.3 PERTINENT DATA

Field surveys were made by Booker Associates, Inc. of St. Louis, Missouri, on 18 April 1979 and 29 May 1979 at the Lower Dam (30717), and on 10 September 1979 at the Upper Dam (31036). Field measurements are valid as of the dates of inspections and surveys. The survey data is presented on Plates 3 through 8 and 11 through 13.

a. Drainage Areas.

(1) Lower Dam (30717) - 649 acres (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(2) Upper Dam (31036) - 102 acres (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

b. Discharge at Damsites.

(1) Lower Dam (30717)

(a) Outlet pipe discharge at maximum pool (PMF El. 954.5 feet) - 5 cfs.

(b) Spillway discharge at maximum pool (PMF El. 954.5 feet) - 3085 cfs.

(c) Maximum experienced outflow at damsite - No available information.

(2) Upper Dam (31036)

(a) Outlet pipe discharge at maximum pool (PMF El. 995.3 feet) - 7 cfs.

(b) Spillway - Outlet pipe is spillway for this dam. Not applicable.

(c) Maximum experienced outflow at damsite - No available information.

c. Elevation (Feet above M.S.L.)[1/]

(1) Lower Dam (30717)

(a) Top of dam - Varies from El. 957.5 to El. 966±.

(b) Streambed at downstream toe of dam - El. 874±.

(c) Maximum pool (PMF) - El. 954.5.

(d) Operating pool - El. 944.0 on 19 April 1979, El. 942.3 on 29 May 1979, El. 942.6 on 23 August 1979.

(e) Spillway crest - El. 944.8.

(f) Top of outlet pipe - El. 942.5 ±.

(g) Invert at end of outlet pipe - El. 913.66.

1/ Elevations are based on established benchmarks of 966.06 feet M.S.L. at the Lower Dam and 1015.93 feet M.S.L. at the Upper Dam maintained by St. Joe Minerals Corporation (Plates 3 and 11).

(2) Upper Dam (31036)

(a) Top of dam - Varies from El. 998.8 to El. 1029.6.

(b) Tailings surface at downstream toe of dam - El. 957.6.

(c) Maximum pool (PMF) - El. 995.3.

(d) Operating pool - El. 986.4 on 23 August 1979.

(e) Spillway crest - Outlet pipe is spillway for this dam. Not applicable.

(f) Top of outlet pipe - El. 986.31.

(g) Invert at end of outlet pipe - El. 971.0.

(h) Tailings surface adjacent to dam - Varies from El. 989.1 to El. 998.2.

d. Reservoirs.

(1) Lower Dam (30717)

(a) Length of maximum pool (PMF) - 1800$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(b) Length of operating pool - 900$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(c) Length of impounded tailings - 7000$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(2) Upper Dam (31036)

(a) Length of maximum pool (PMF) - 2000$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(b) Length of operating pool - 900$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

(c) Length of impounded tailings - 2000$\pm$ feet (Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978).

e. Storage Above Tailings Surface.

(1) Lower Dam (30717)

(a) Top of dam (El. 957.5 feet) - 875 acre-feet.

(b) Maximum pool (PMF El. 954.5 feet) - 637 acre-feet.

(c) Spillway crest (El. 944.8 feet) - 137 acre-feet.

(d) Top of outlet pipe (El. 942.5$\pm$ feet) - 74 acre-feet.

(2) Upper Dam (31036)

(a) Top of dam (El. 998.8 feet) - 479 acre-feet.

(b) Maximum pool (PMF El. 995.3 feet) - 291 acre-feet.

(c) Spillway crest - Outlet pipe is spillway for this dam. Not applicable.

(d) Top of outlet pipe (El. 986.31 feet) - 11 acre-feet.

f. Reservoir Surface Areas.

(1) Lower Dam (30717)

(a) Top of dam (El. 957.5 feet) - 86 acres.

(b) Maximum pool (PMF El. 954.5 feet) - 73 acres.

(c) Spillway crest (El. 944.8 feet) - 32 acres.

(d) Top of outlet pipe (El. 942.5$\pm$ feet) - 23 acres.

(2) Upper Dam (31036)

(a) Top of dam (El. 998.8 feet) - 58 acres.

(b) Maximum pool (PMF El. 995.3 feet) - 50 acres.

(c) Spillway crest - Outlet pipe is spillway for this dam. Not applicable.

(d) Top of outlet pipe (El. 986.31 feet) - 10 acres.

g. Dams.

(1) Lower Dam (30717)

(a) Type - Earthfill, and cycloned and spigoted tailings.

(b) Crest length - 2130$\pm$ feet.

(c) Height (maximum above streambed) - 84 feet at Station 13+41.

(d) Crest width - 20 to 40 feet.

(e) Side slopes -

- Downstream: 2(H) to 1(V) for earthfill, variable between 6(H) to 1(V) and 1.5(H) to 1(V) for tailings.

- Upstream: 5(H) to 1(V).

(f) Zoning - Homogeneous earthfill dam enlarged using cycloned and spigoted tailings ("chat") (Plate 10).

(g) Cutoff - An excavated cutoff is shown on a sketch of the earthfill dam provided by the owner (Appendix B).

(2) Upper Dam (31036)

(a) Type - Cycloned tailings.

(b) Crest length - 3850$\pm$ feet.

(c) Height (maximum above tailings surface at downstream toe) - 50 feet at Station 11+65.

(d) Crest width - 15 to 30 feet.

(e) Side slopes -

- Downstream: Variable betweem 2(H) to 1(V) and 4(H) to 1(V).

- Upstream: Variable between 2.5(H) to 1.0(V) and 10(H) to 1(V).

(f) Zoning - Homogeneous cycloned, fine sand tailings.

(g) Cutoff - The Upper Dam is constructed directly upon lead tailings impounded by Lower Dam and has no cutoff.

h. Spillways.

(1) Lower Dam (30717)

(a) Type - Uncontrolled trapezoidal open channel at right abutment.

(b) Control section - 26-foot bottom width, 16-foot depth, 75-foot top width, and approximate side slopes of 1.5(H) to 1.0(V) and 1.3(H) to 1.0(V).

(c) Crest elevation - El. 944.8 feet.

(d) Upstream channel - There is no upstream channel.

(e) Downstream channel - Open cut channel draining into an intermittent stream channel.

(2) Upper Dam (31036): Outlet pipe is spillway for this dam which has an open cut downstream channel draining into the Lower Dam pond. Not applicable. (See Section 1.3i.)

i. Outlets.

(1) Lower Dam (30717)

(a) Type - 12-inch diameter steel pipe with a 19-inch diameter vertical riser section at the inlet.

(b) Length - 1400$\pm$ feet.

(c) Upstream invert - El. 942.5$\pm$ feet at top of vertical riser.

(d) Downstream invert - El. 913.66 feet.

(e) Entrance shape - Square-edged.

(f) Slope - Estimated to be between 1.5 and 2.0 percent.

(g) Flow - 1.5$\pm$ cfs on 17 April 1979.

(2) Upper Dam (31036)

(a) Type - 12-inch diameter steel pipe with a 20-inch diameter vertical riser section at inlet that funnels down to 12 inches.

(b) Length - 400$\pm$ feet.

(c) Upstream invert - El. 986.31 feet at top of vertical riser and El. 980.76 feet at bottom of vertical riser.

(d) Downstream invert - El. 971.0 feet.

(e) Entrance shape - Square-edged.

(f) Slope - Estimated to be 2.4 percent.

(g) Flow - 1.0$\pm$ cfs on 23 August 1979.

j. Regulating Oulets. None.

k. Diversion Ditches.

(1) Lower Dam (30717): The old left abutment spillway diverts a small upstream drainage away from the tailings dam crest.

(2) Upper Dam (31036): None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Some design drawings for the original earthfill starter dam at the Lower Dam site were known to the owner and were made available to the inspection team. An original sketch dated 11 August 1952 shows two sections and is presented in Appendix B. A drawing entitled "Location of Tailings Disposal Dam 8/11/52" and a drawing entitled "Tailings Dam/St. Joseph Lead Company" by the General Engineering Company and dated 28 November 1952 were shown to the inspection team. The first drawing dated 11 August 1952 was a topographic map showing the location of the dam. The second drawing illustrated the progress made in construction as of 28 April 1953. No written information describing the types of construction materials used was found. No design drawings or data pertaining to the design of the Upper Dam (31036) are known to exist.

2.2 CONSTRUCTION

No written records pertaining to the construction of the Lower Dam (30717) or the Upper Dam (31036) other than those described above were available, and no eyewitnesses to the construction were found. A summary of tailings disposal operations at the Indian Creek Mine Dams was provided by St. Joe Minerals Corporation and is presented in Appendix B The original earthfill starter dam at the Lower Dam site was constructed of locally available residual soils during 1953. The tailings were deposited in the pond by gravity flow. Several enlargements to the starter dam were made to maintain freeboard. These enlargements were estimated to have raised the crest of the starter dam by approximately eight feet. The dam was enlarged in 1956, 1957, 1959, and 1960. The upper crest was constructed in 1971 through 1976 by spigot pipelines on the tailings to create additional freeboard. Also, a rock berm was placed at the downstream toe between 1960 and 1962 to control slumping of the starter dam. Deposition of tailings behind the Lower Dam ceased between 1973 and 1975.

An intermediate dam about 3,000 feet upstream of the original earthen dam at the Lower Dam site was constructed as a cross-valley dam in 1961. Cycloned tailings were used to construct the dam, and between 1961 and 1971, the dam was raised several times using tailings. In 1977 construction of the valley-side Upper Dam (31036) was started immediately upstream of the intermediate dam. The north leg of the U-shaped Upper Dam is actually an enlargement of the intermediate dam. From 1977 to the present, cycloned lead tailings have been used to enlarge the Upper Dam which is built upon tailings impounded by the lower and intermediate dams. At the time of inspection the south leg of the dam was being raised approximately 12 feet in an upstream direction. The position of the downstream or exterior slope was being maintained while enlargement of the dam progressed toward the interior of the impoundment. Coarse lead tailings were being deposited onto the crest from a cyclone suspended from a crane. The finer lead tailings were being deposited into the impoundment in a slurry form. The enlargement of the Upper Dam was progressing from the south leg to the north leg around the impoundment.

2.3 OPERATION

No operating records for the Lower Dam (30717) or the Upper Dam (31036) are known to exist. Fine lead tailings are being conveyed as a slurry into the Upper Dam impoundment from a cyclone operation on the embankment crest. Outflow from the Upper Dam passes through an uncontrolled, 12-inch diameter outlet pipe into an excavated drainage channel which drains into the Lower Dam pond. Water from the Lower Dam pond is recycled back to the mill. Outflow from the Lower Dam passes through an uncontrolled, open channel spillway and a 12-inch diameter outlet pipe.

2.4 EVALUATION

a. Availability. Limited design information was available. No construction or operating records are known to exist. The only construction and operating information available to the inspection teams was a summary of tailings disposal operations at the Indian Creek Mine Dams provided by St. Joe Minerals Corporation, information which was obtained through verbal communication with the owner's representatives, observations and during field inspection.

b. Adequacy. No written records exist to substantiate the sections shown on the design drawings for the Lower Dam (30717); therefore, this information is not considered reliable and conclusions concerning the safety of the Lower Dam should not be based on this source. The field surveys and visual inspections for the Lower Dam and Upper Dams documented herein are considered adequate to support the conclusions made in this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, and this lack of information is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

c. Validity. The earthfill dam may not have been constructed as shown in the design section. No quality control records are known to exist.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The Lower Dam (30717) was inspected by a civil engineer and an engineering geologist from International Engineering Company, Inc. on 17 April 1979. The Upper Dam (31036) was inspected by two civil engineers from International Engineering Company, Inc. on 23 August 1979. Mr. John Kennedy, Director of Environmental Control for St. Joe Minerals Corporation, met with the inspection teams and toured the damsites with them during both inspections. Rich Brand, Indian Creek Mine Mill Superintendent, was also present during the inspections and described the construction and operating history of the impoundments. He supplied the inspection team with available design drawings for the Lower Dam. The lower impoundment is an inactive lead tailings pond; water retained here is pumped to and used in mill operations. The upper impoundment is an active lead tailings disposal site. Photographs taken during both inspections are included in this report. Field locations of the photographs are shown on Plates 9 and 14.

b. Project Geology. Most of the watershed area is covered by residual soil overburden with depths to 25 feet. Residual soils consist of reddish-brown gravelly, sandy clay. Bedrock exposures are limited to a few outcrops in the downstream channel, at the Lower Dam along the creek bed, and at the dam toe near the right abutment. A few outcrops exist in the drainage channel which passes along the west side of the Upper Dam and drains into the Lower Dam pond, and bedrock is exposed in a rock cut made for this channel directly west of the Upper Dam. Bedrock consists of bedded sandstone, which is the basal member of the Gasconade Formation. It is light gray, thickly bedded, and relatively undeformed.

c. Dams.

(1) Lower Dam (30717): The plan of the Lower Dam is shown on Plate 3. Profiles and cross sections of the earthen and tailings dams, spillway, and diversion ditch are shown on Plates 4 through 8.

The tailings portion of the dam is almost devoid of vegetation. The downstream slope of the original earthfill starter dam is covered with grasses.

The dam consists of an earthfill starter dike and an enlargement that was built of coarse tailings placed on top of old tailings directly upstream of the original starter dike. This indicates the use of an upstream construction method. An interpretive section through the dam is shown on Plate 10. Wind erosion is causing some shifting of the fine sands composing the tailings embankment from the upstream to the downstream direction. No evidence of sliding, cracking, settlement, or animal burrows was noted.

Large erosion gullies are present at the right abutment contact and along the downstream slopes of the rock berm and the downstream slopes of the starter dam. These gullies appear to have been caused by runoff, however, seepage is also a contributing factor. Some erosion gullies

appeared to result from off-road vehicle traffic. Some evidence of past sloughing of the starter dam was observed at the end of the rock berm. This probably occurred while the lower pond was in operation. A well defined seepage line that exits on the downstream slope of the tailings is visible. Tailings are present along most of the toe of the dam and at the bench at the top of the old starter dam. The downstream slopes of the tailings are variable and approach the angle of repose for lead tailings.

Considerable seepage was observed along the downstream slope of the dam from approximately Station 7+00 to Station 22+00. A distinct wetting line is visible along the downstream tailings embankment surface, and seepage and piping of tailings is occurring approximately six inches below this wetting line. Seepage was also noted exiting from the tailings embankment near both abutments. Seepage was observed along the toe of the starter dam. Marshy ground and tailings are present at the dam toe. A spring was observed at the base of the rock berm at the maximum section (Station 13+41) flowing clear at 5 gpm. The ground is marshy and soft in this area.

The crest of the tailings dam curves upstream near the left abutment. A small pond that contains collected runoff diverted from the dam is located near the left abutment. Water from this pond seeps through the tailings and eventually reaches the old left abutment spillway, which now functions as a diversion ditch. Flow in this channel was estimated to be approximately 25 gpm near the old overflow structure.

Observed freeboard at the dam was estimated to be about 16 feet at the time of the inspection. No erosion or slope protection other than that provided by grass growing on the starter dam was observed. The rock berm at the toe is inadequate to prevent erosion caused by concentrated runoff.

No evidence of instability was observed at either abutment. Both abutments are underlain by residual soil overburden. Bedrock is probably less than 25 feet below the surface at both abutments.

(2) Upper Dam (31036): The plan of the Upper Dam is shown on Plate 11. The profile and cross sections of the dam are shown on Plates 12 and 13.

The Upper Dam is devoid of any vegetation with the exception of a few trees growing through the tailings on the exterior slope in the area of the left abutment. A few dead tree snags protrude through the embankment slopes near the left and right abutments.

No detrimental settlement, depressions, cracks, sinkholes, animal burrows, or slope instability were observed in the embankment within the area where enlargement was not taking place (between the right abutment and Station 29+25). It was evident that wind erosion is causing some shifting of the fine sands composing the tailings embankment and has deposited them on the upper portion of the downstream slope near the crest. The dam crest is very rounded and ripples in the fine sand tailings were observed.

Considerable erosion on both the interior and exterior slopes within the enlarged section on the south leg of the dam (between Station 29+25 and the left abutment) has occurred. Many large erosion gullies up to several feet deep exist on the downstream or exterior slope near the crest. A majority of these gullies originate at the joints in the tailings discharge pipe from the mill which is laid along the crest. Cracking of the embankment was evident adjacent to the gullies. Erosion from runoff over the recently deposited tailings within the enlarged section was evident. Considerable erosion has occurred along the toe of the upstream or interior slope due to discharge of the fine lead tailings into the impoundment near the toe. This erosion has caused near-vertical scarps several feet high along the interior toe of the enlarged section.

Considerable seepage was observed along the toe of a majority of the dam. A distinct wetting line along the downstream tailings embankment surface was visible below which a well defined seepage line exits near the toe. This seepage was most evident along the north leg of the dam in the area of the maximum section. The seepage is causing movement and piping of tailings as evidenced by removal of material at the seepage line. The tailings within the enlarged embankment area contain more water than those comprising the remainder of the dam. Seepage from within the embankment itself in this area has caused some piping, slumping, cracking, and erosion along the embankment slopes. The fine sand tailings near the toe of the interior slope, near the toe of the exterior slope within the enlarged area, and at the toe of the exterior slope along the north leg of the dam are loose and saturated and cannot support the weight of a man.

The elevation difference between the dam crest and the tailings surface adjacent to the dam within the area where enlargement was not taking place ranged from about 8 to 18 feet on the date that the survey was made (10 September 1979). The elevation difference between the dam crest and the tailings surface adjacent to the dam within the enlarged area ranged from about 24 to 26 feet on the date of survey. The elevation difference between the low point in the dam crest and the top of the outlet pipe was 12.5 feet on the date of survey. There is no slope protection on either upstream or downstream slope of the Upper Dam.

No evidence of instability or seepage was observed at either abutment. Both abutments are underlain by residual soil overburden. It did not appear that any clearing or stripping of underbush and trees had been done at the left abutment where enlargement had recently taken place. Erosion was observed at the left abutment contact on the interior side of the impoundment due to mill discharge at this location. There was evidence of some clearing of bush and trees at the right abutment. Erosion has occurred along the right abutment adjacent to the downstream face of the dam.

d. Appurtenant Structures.

(1) Lower Dam (30717): The existing spillway channel has been excavated through the right abutment approximately 100 feet from the

dam-abutment contact. Runoff discharges into an adjacent natural drainage channel. The adjacent channel discharges into the main channel approximately 2000 feet downstream from the dam.

The spillway is an open cut trapezoidal channel excavated into the gravelly, sandy clay residual soil overburden. The side slopes vary and have an average slope of 1-1/4(H) to 1(V). The bottom of the channel is approximately 20 feet wide. There are no approach channels, stilling basins, or energy dissipators at this site.

A 12-inch diameter steel outlet pipe is located downstream of the crest at Station 11+74 and discharges downstream of the embankment. The inlet is a 19-inch diameter vertical riser pipe with a one foot section of 24-inch diameter pipe attached near the top so that outflow enters through the annular space between the pipes. The outlet pipe is an uncontrolled structure, and flow was estimated at 1.5 cfs on 19 April 1979. Water passing through the outlet appeared to be cloudy. No energy dissipator exists at the outlet, and outflow has eroded the soil to bedrock and is flowing down a steep section of the right abutment to a point 20 feet beyond the toe. There is no outlet channel, and no drawdown capacity exists below the elevation of the top of the riser pipe (El. 942.5± feet).

A small diversion dike has been constructed between the crest at approximately Station 24+00 and the original earthfill dam adjacent to the left abutment. This structure diverts runoff from two sidehill drainages to an old spillway on the left abutment.

(2) Upper Dam (31036): The spillway is an uncontrolled 12-inch diameter steel outlet pipe with a 20-inch diameter vertical riser section at the inlet that reduces down to 12 inches. The height of the vertical riser section as measured on the date of survey (10 September 1979) was 5.55 feet, and the inlet is square-edged. The outlet is approximately 400 feet long with an estimated slope of 2.4 percent and is located near the right abutment. Surrounding the vertical riser inlet is a wood frame with screens attached to prevent debris from entering the outlet. The screens were not fully intact. The outlet discharges into an excavated drainage channel which begins about 20 to 30 feet from the toe of the Upper Dam at the base of the right abutment and drains into the lower dam pond. The outlet was flowing about one fourth full at the time of inspection (23 August 1979), and the water appeared to be cloudy. The flow rate was estimated at 1.0 cfs. The outlet discharges about two to three feet above the invert of the downstream channel and has no energy dissipators. No drawdown capacity exists below the elevation of the top of the riser pipe (El. 986.31 feet).

e. Reservoir Areas.

(1) Lower Dam (30717): The lower tailings pond consists of saturated, loose, fine sands. No vegetation is growing on the tailings surface except for some grasses that have been planted on the older tailings south of the Upper Dam. Dead tree snags exist along the fringes of the tailings deposit. No evidence of landslides or excessive

erosion was found along the shoreline of the tailings area; a majority of the tailings area is bordered by drainage channels. A few roads pass through the area, but the watershed remains largely undisturbed. Little natural sedimentation of the reservoir is occurring. No structures exist upstream of the dam that may be subject to backwater flooding.

(2) Upper Dam (31036): The upper tailings pond also consists of saturated, loose, fine sands. No vegetation is growing on the tailings surface. Dead tree snags exist along the shore of the tailings deposit. The small watershed of the Upper Dam is heavily forested and remains in its natural state with no evidence of landslide or excessive erosion activity. No structures exist upstream of the dam that may be subject to backwater flooding.

f. Downstream Channels.

(1) Lower Dam (31036): The channel downstream of the Lower Dam is mantled by residual soil with sandstone bedrock exposed on the floor of the creek. The channel area is undeveloped and heavily forested.

(2) Upper Dam (31036): An open cut trapezoidal channel in existing residual soil provides drainage for the outlet pipe downstream of the Upper Dam to the back of the Lower Dam pond. The channel follows the eastern edge of the tailings impounded between the Lower Dam and the Upper Dam. The channel bottom varies from four to eight feet wide, and the side slopes are approximately 2(H) to 1(V). The channel bottom is sandy and has a slope of approximately one percent.

Adjacent to the Upper Dam on its west side is an open cut trapezoidal channel in existing residual soil that provides drainage for the western portion of the Lower Dam watershed and prevents runoff from this area from flowing onto the tailings impounded between the Upper and Lower Dams and the tailings south of the Upper Dam. The drainage channel is approximately two miles long and has variable side slopes and bottom widths throughout this distance. Typical side slopes are 3(H) to 1(V), and the channel bottom width is typically five to ten feet wide. The excavated channel is devoid of vegetation and the channel bottom is typically sandy with siltation in the flatter areas. The channel slope is typically on the order of one half of one percent except through a rock cut directly west of the Upper Dam. The channel follows the western edge of the tailings impounded behind the Lower Dam, and it drains into the back of the Lower Dam pond.

3.2 EVALUATION

a. Lower Dam (30717). This dam has serious deficiencies that threaten the stability of the embankment. The tailings dam is constructed of fine sand (coarse tailings) and silts and is founded on older lead tailings consisting of loose, fine sand and silt that were deposited by gravity flow and retained by the original earthfill starter dam. It is evident that the tailings are saturated at least to the height of the downstream starter dam, and seepage and piping of tailings is occurring at this saturated

zone. Because of the gradation of the tailings and the water level within them, this dam could be subject to liquefaction and must be considered potentially unstable. Also, the dam could become unstable should a sufficient depth of water be impounded in the reservoir.

Erosion of the dam due to runoff, seepage, and use by off-road vehicles was observed in many areas. The seepage and runoff causes local sloughing of the tailings. There is no protection against wave erosion on the upstream face of the dam. Seepage and soft marshy ground was noted along the downstream toe of the starter dam. This condition could weaken the foundation clay soil by saturation and adversely affect the stability of the dam.

b. Upper Dam (31036). This dam has serious deficiencies that threaten the stability of the embankment. It is being constructed of cycloned coarse lead tailings of which a majority is fine sand. The dam is founded on older lead tailings consisting of loose, fine sand and silt, and it is retaining new cycloned fine lead tailings consisting of loose, fine sand and silt. The impounded tailings are saturated and it is evident that water from these tailings is draining through the embankment and into the foundation creating a loose, soft, and saturated condition along the toe of the dam and in the foundation which could adversely affect embankment stability. Furthermore, construction practices being used to enlarge the dam are causing considerable erosion on both upstream and downstream slopes and added seepage through the embankment which is resulting in piping and slumping. These conditions plus the fact that enlargement is being done by an upstream method pose hazards to the stability of the structure. The dam could become unstable if a sufficient depth of water is impounded. Also, the potential for liquefaction of the sand tailings exists.

There is no erosion protection for any part of the dam. The erosion by wind and surface runoff can adversely affect the stability of the dam.

A 12-inch diameter outlet provides the only means of outflow for the dam. No open channel spillway exists; the low point of the dam is at the right abutment, but this cannot be considered a spillway because of the highly erodible nature of the tailings comprising the dam. Once overtopping occurs at this point, considerable erosion of the dam would take place. If the outlet pipe were to become plugged, water could become impounded to such a depth as to make the dam unstable.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

No regulating procedures are known to exist for these dams. The Upper Dam (31036) is continually being raised to provide additional tailings storage capacity. Outflow passes through an uncontrolled outlet pipe near the right abutment into a drainage channel which drains into the Lower Dam pond. Water retained by the Lower Dam (30717) is recycled back to the mill. Outflow from this dam passes through an uncontrolled outlet pipe and an uncontrolled spillway channel at the right abutment.

4.2 MAINTENANCE OF DAMS

a. Lower Dam (30717). A program of routine maintenance is carried out at the Lower Dam. The owner was placing rock on the crest of the Lower Dam to serve as road base at the time of the inspections, and John Kennedy, Director of Environmental Control for St. Joe Minerals Corporation, stated that grass was to be planted on the downstream tailings slopes at the Lower Dam. He also stated that the outlet through the Lower Dam was scheduled to be plugged with concrete before the end of 1981.

b. Upper Dam (31036). The Upper Dam is currently being enlarged to provide additional tailings storage capacity, and, therefore, maintenance of the dam is not strictly practiced. Coarse lead tailings are being deposited in an upstream direction toward the interior of the pond by a cyclone suspended from a crane on the crest of the enlarged embankment section.

4.3 MAINTENANCE OF OPERATING FACILITIES

There are no operating facilities at these dams. Not applicable.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

Information available to the inspection teams indicates that there are no warning systems for either the Lower or Upper Dam.

4.5 EVALUATION

An inspection program for both dams should be initiated so that indications of instability, such as cracks in the dams, sloughing, sudden settlement, erosion of the dams or Lower Dam spillway, or an increase in the volume or turbidity of emerging seepage can be monitored. The slopes of the lead tailings should be stabilized, and better erosion control methods are needed. The water level on the lower impoundment should be maintained at the lowest possible level consistent with operational requirements.

SECTION 5 - HYDRAULIC AND HYDROLOGIC ANALYSES

5.1 EVALUATION OF FEATURES

a. Design Data. The significant dimensions of the dams, spillway, and outlet pipes are presented in Section 1 - Project Information, and in the accompanying field survey drawings, Plates 3 through 8 and 11 through 13. No hydrologic or hydraulic design information is available.

For this evaluation, the watershed drainage area and reservoir areas were obtained from a Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978. Stream lengths were obtained from the USGS Richwoods, Mo., 1946, 15 minute series, 1:62,500 scale, topographic quadrangle.

The total drainage area of the Indian Creek Mine Lower Dam (30717) is 751 acres (1.17 square miles). The watershed and drainage boundary are shown on Plate 2. The watershed was divided into two subareas as follows:

Subarea	Incremental Drainage Area (Acres)
1. Watershed above Upper Dam (31036)	102
2. Watershed above Lower Dam (30717)	649

The soil type, land use, and vegetation pattern of the watershed were determined from field observations and aerial photographs. The soil group for this watershed is classified as Goss Cherty Loam, equivalent to hydrologic soil group B classification, which has a moderate rate of water transmission. The new tailings have a more rapid rate of water transmission. The type of land cover and land use were used to estimate runoff curve numbers (CN) for the antecedent moisture conditions (AMC), which determine the amount of infiltration, retention losses, and net runoff.

The data and assumptions used in the hydrologic and hydraulic analyses for each subarea are individually discussed below. Basin parameters such as lag time, unit hydrograph, probable maximum precipitation, losses and net runoff for each subarea are presented in Appendix A.

Subarea 1 - Watershed above Upper Dam (31036)

The drainage area of this subarea is 102 acres (0.16 square miles). The watershed was divided into the following types of land use and vegetal cover:

Type of Cover	Approximate Percent of Watershed
New Tailings	48
Undisturbed Woodland	42
Reservoir	10

The estimated runoff curve numbers (CN) weighted according to the above land cover distribution are CN 64 for the AMC II condition and CN 81 for the AMC III condition.

The outlet for the Upper Dam impoundment is a 12-inch diameter steel pipe with a 20-inch diameter vertical riser section at the inlet. The pipe is approximately 400 feet long and passes beneath the dam near the right abutment. The invert elevations of the inlet and the outlet are El. 986.31 feet and El. 971.0 feet, respectively. The vertical riser section is 5.55 feet tall. The initial reservoir water surface elevation was assumed to be at the existing elevation of El. 986.4 feet at the time of inspection (23 August 1979). Water is discharged directly to the lower drainage area from the Upper Dam outlet.

The discharge rating curve for the pipe outlet was computed considering weir flow, orifice flow, and pipe flow conditions at different reservoir water surface elevations. Due to the small size of the pipe outlet (12-inch diameter), the computed outflows are relatively small, in the range of 1 to 7 cubic feet per second. The reservoir water surface elevation-discharge relationship is shown in Appendix A, under the input data listing as Y4 and Y5 cards for the upper pond, and also in the computer printout.

The reservoir area-capacity curve data are shown in Appendix A. The capacities shown, as computed by the Conic Method in the computer program, are the capacities above the minimum El. 986.3 feet that were entered as input and are not the total reservoir capacities at the given elevations.

Subarea 2 - Watershed above Lower Dam (30717)

The incremental drainage area above the Lower Dam is 649 acres (1.01 square miles). The watershed was divided into the following types of land use and vegetal cover:

Type of Cover	Approximate Percent of Watershed
New Tailings	16
Developed Area	3
Undisturbed Woodland	76
Reservoir	5

The estimated runoff curve numbers (CN) weighted according to the above land cover distribution are CN 57 for the AMC II condition and CN 75 for the AMC III condition.

A road (Route 185) crosses the southern part of this watershed and has three arch culverts passing beneath the road embankment. The arch culverts, two of which are 48 inches by 38 inches and the third is 54 inches by 38 inches in size, are about 500 feet and 1000 feet apart from east to west. One of them is somewhat silted at the outlet, and the other two are open according to the field investigations. It was assumed that these culverts are able to carry all the runoff from the drainage area

above the road without any storage effect. Runoff is then drained to the lower pond through an open cut earth channel along the west side of the tailings deposit.

There are two outlets for the Lower Dam impoundment. An open cut trapezoidal spillway channel is located at the right abutment and a 12-inch diameter steel outlet pipe with a 19-inch diameter vertical riser section at the inlet passes beneath the dam near the right abutment. The outlet pipe is approximately 1400 feet long. The two outlets are individually discussed below:

(1) Spillway Channel: The crest of the spillway channel located at the east end of the dam is at El. 944.8 feet according to field surveys. A wooden bridge supported on three pairs of 12-inch diameter wooden piers crosses the spillway near its crest. The obstruction effect of the piers was taken into consideration as energy loss and added to the velocity head. Two methods were used to calculate the spillway discharge rating curve.

- Critical flows at different flow depths were computed using the critical flow formula.

- Manning's equation for uniform flow using an average slope of 0.025 and a Manning's "n" of 0.04.

The results computed by the critical flow formula were adopted as more representative of the flow conditions. The corresponding velocity heads and energy loss caused by obstruction were added to the depths of flow over the spillway crest to obtain the reservoir water surface elevation versus discharge relationship.

(2) 12-inch Diameter Steel Outlet Pipe with 19-inch Diameter Vertical Riser: The elevation of the top of the vertical riser section of the outlet pipe at the inlet is El. 942.5±, and the invert elevation at the outlet is El. 913.66 feet. The discharge rating curve was computed assuming a pipe flow condition since the initial water surface elevation of the reservoir was assumed at El. 944.8 feet. Head losses for the pipe flow include entrance loss, bending loss, friction loss and miscellaneous losses. Pipe roughness was assumed equivalent to a Manning's "n" of 0.015.

The discharges computed from the pipe are relatively small and negligible compared to the computed spillway discharges. The combined discharge rating curve data are shown in Appendix A under the input data listing as Y4 and Y5 cards for the lower pond, and also in the computer printout.

The reservoir area-capacity curve data are shown in Appendix A. The capacities shown, as computed by the Conic Method in the computer program, are the capacities above the minimum El. 944.0 feet that were entered as input and are not the total reservoir capacities at the given elevations.

b. Experience Data. Recorded rainfall, runoff, or other experience data are not available.

c. Visual Observations. Visual observations are described in Section 3 - Visual Inspection.

d. Overtopping Potential. Analysis of the overtopping potential at the Indian Creek Mine Dams were divided into the following steps:

- Compute floods for Subarea 1, the Upper Dam (31036) watershed and reservoir, and route the floods through the Upper Dam.
- Compute floods for Subarea 2, the Lower Dam (30717) watershed and reservoir.
- Combine the routed outflows from Subarea 1 and the computed inflows from Subarea 2.
- Route the combined floods through the Lower Dam.

The 10-year and 100-year floods, the probable maximum flood (PMF), and floods expressed as percentages of PMF were individually computed as described above. The PMF is defined as the hypothetical flood event that would result from the most severe combination of critical meterorologic and hydrologic conditions that are reasonably possible at a particular location or region. The Modified Puls Method was used for reservoir routing.

For all cases of the reservoir flood routings, the level of the reservoir surface was set at El. 986.4 feet for the Upper Dam, the observed water surface elevation behind the embankment, and at the spillway crest El. 944.8 feet for the Lower Dam at the start of the floods. In the spillway routing at the Lower Dam, it was assumed that erosion of the spillway channel would not occur as flood discharges increase; therefore, the spillway discharge rating curve was computed for a specific cross section and configuration.

Results of the overtopping analyses indicate that both the Upper and the Lower Dams can pass the PMF without overtopping the dam crests. At the PMF, the maximum reservoir water surface elevation for the Upper Dam (31036) is El. 995.3 feet while the minimum dam crest elevation is El. 998.8 feet. The maximum reservoir water surface elevation for the Lower Dam (30717) under the PMF condition is El. 954.5 feet, which is below the minimum dam crest elevation of El. 957.5 feet. The combined PMF peak outflow from the lower pond is 3090 cubic feet per second, with a flow depth of 6.9 feet and a flow velocity of 13.1 feet per second at the spillway section. Such a high velocity would cause significant erosion of the spillway channel.

A major consideration in evaluating the safety of the dams is assessing the potential for overtopping and the subsequent failure of the embankment as a result of erosion. Since the spillway of the Lower Dam is composed of erodible materials, high velocity discharges through the spillway could lead to significant erosion of the spillway; however, erosion of the spillway channel will not endanger the embankment. The spillway is

separated from the embankment at the right abutment and it discharges into an adjacent drainage. Based on the Corps of Engineers Manual EM 1110-2-1601, "Hydraulic Design of the Flood Control Channels", the maximum permissible velocity for the residual soils found in the spillway channel is estimated to be about 4 feet per second. Using this as a criterion, the spillway control section can only pass about 3 percent of the PMF without significant erosion.

Another consideration that must be addressed is that both the Upper Dam and Lower Dam are constructed of fine sand tailings and could become unstable if sufficient depths of water are impounded to saturate the embankments and accelerate seepage and piping.

Results of the overtopping analyses are presented in Appendix A and are summarized on the following page.

Flood	Upper Dam (31036)3/			Lower Dam (30717)2/					
	Peak Inflow (cfs)	Peak Outflow (cfs)	Max Res WS Elev (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Max Res4/ WS Elev (ft)	Spillway Flow Depth (ft)	Spillway Flow Velocity (ft/sec)	Duration Spillway Vel. Over 4 ft/sec (hrs)
3% PMF	56	3	986.9	127	48	945.6	0.6	3.9	-
25% PMF	469	6	989.9	1040	694	948.9	2.9 1/	8.7 1/	17.3
50% PMF	937	7	992.1	2075	1471	951.2	4.6 1/	10.3 1/	21.5
75% PMF	1406	7	993.8	3109	2295	953.0	5.8 1/	12.1 1/	23.8
PMF	1874	7	995.3	4144	3090	954.5	6.9 1/	13.1 1/	25.0
100-Yr	206	5	988.2	314	156	946.6	1.3 1/	5.6 1/	14.0
10- Yr	109	4	987.5	155	69	945.8	0.7 1/	4.2 1/	7.0

1/ These flow depths and velocities are considered to produce the effects of significant erosion.

2/ Minimum dam crest - El. 957.5 feet.

3/ Minimum dam crest - El. 998.8 feet.

4/ Reservoir water surface elevations include the velocity heads corresponding to the velocities computed at the spillway control section.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. The conditions which adversely affect the structural stability of these dams are discussed in Section 3.

b. Design and Construction Data. Limited design and no construction data pertaining to the structural stability of the dams were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, and lack of this information is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

c. Operating Records. No appurtenant structures requiring operation exist at these dams and no records are known to exist.

d. Post Construction Changes.

(1) Lower Dam (30717): A toe buttress was built at the lower earthfill dam in 1960 to correct an instability problem. The crest of this earthfill dam was also raised approximately eight feet during the period between 1954 and 1961. Rock was being placed on the dam crest during the inspection to provide an access road. No other post construction changes are evident.

(2) Upper Dam (31036): The dam is currently being raised. Not applicable.

e. Seismic Stability. The dams are located in Seismic Zone 2, as defined in the Uniform Building Code. Slides and slope failures could occur where the downstream slopes are relatively steep. There is a high potentia' for liquefaction at both dams where the foundations and embankment materials consist of loose, saturated fine sand tailings. The clayey foundation soils at the site may have a potential for deformation.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety.

(1) Lower Dam (30717): The lower dam has several deficiencies that affect its stability and that should be corrected. (1) The last 30 feet of the embankment height was obtained by using an upstream hydraulic construction method with fine sand tailings constructed on a foundation consisting of loose, saturated fine sand and silt tailings. The dam should be considered potentially unstable, particularly when subjected to earthquake loads or high reservoir stages. (2) The seepage, piping, and erosion of tailings adversely affect embankment stability. The fine sand tailings provide little resistance to piping and surface erosion, and the dam could become unstable if a sufficient depth of water is impounded to accelerate piping. (3) The high phreatic surface within the embankment system also indicates potential stability problems associated with the earthfill starter dam. As mentioned in Section 2, a rock toe berm was constructed at the downstream toe of the starter dam to increase stability. (4) The soft and marshy ground at the toe of the dam adversely affects embankment stability. (5) There is a lack of adequate erosion protection on the downstream slopes as evidenced by severe surface erosion. No erosion protection has been provided on the upstream slope. (6) Seepage and stability analyses were not available, and they should be performed and made a matter of record. (7) The combined discharge capacity of the spillway and outlet was computed to be adequate to pass 100 percent of the probable maximum (PMF) without overtopping the dam. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that is reasonably possible in the region. The "Recommended Guidelines for Safety Inspection of Dams" specifies that the spillway design flood for this dam should be the PMF. Although the hydrologic analysis shows the Lower Dam capable of passing the PMF without overtopping, high velocities at the spillway section would cause significant erosion of the spillway channel, and the high level of impounded water could cause accelerated seepage and piping, reducing embankment stability. Erosion of the spillway channel, however, will not endanger the embankment.

(2) Upper Dam (31036): The Upper Dam has several deficiencies that affect its stability and that should be corrected. (1) The embankment is being increased in height by an upstream hydraulic construction method using fine sand tailings constructed on a foundation consisting of loose, saturated fine sand and silt tailings. The dam should be considered potentially unstable, particularly when subjected to earthquake loads or high reservoir stages. (2) The seepage, piping, and erosion occuring along the toe of the dam and the soft and saturated conditions downstream and beneath the dam adversely affect embankment stability. The dam could become unstable if a sufficient depth of water is impounded to accelerate piping. (3) The erosion gullies on the exterior face along

the enlarged section and the erosion scarps at the toe of the interior slope along the enlarged section adversely affect embankment stability. (4) No erosion protection has been provided on the upstream and downstream faces of the dam. (5) The dam has no overflow structure such as an open channel spillway in the event the outlet pipe became plugged. (6) Seepage and stability analyses were not available, and they should be performed and made a matter of record. (7) The storage capacity of the dam was computed to be adequate to retain the PMF. The "Recommended Guidelines for Safety Inspection of Dams" specifies that the spillway design flood for this dam should be the PMF. Although the hydrologic analysis shows the Upper Dam capable of retaining the PMF without overtopping, the high level of impounded water could cause accelerated seepage and piping, reducing embankment stability, and should the outlet become plugged, no overflow channel exists to prevent overtopping and significant erosion of the embankment.

b. Adequacy of Information. Limited design and no construction data were available for the Lower Dam (30717), and no design or construction data were available for the Upper Dam (31036). Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, and this lack of data is considered a deficiency.

Results of the hydrologic studies could be changed if larger scale and more up to date topographic maps with smaller contour intervals were used. The only available topographic map at the time of this inspection is the USGS Richwoods, Mo., 1946, 15 minute series, 1:62,500 scale, topographic quadrangle with contour intervals of 20 feet. This topographic data is inadequate due to the fact that the mining activity and dam construction occured subsequent to the publication of the quadrangle map. Watershed drainage areas and reservoir areas were measured from a Surdex aerial photograph, scale: 1 inch = 1000 feet, 14 May 1978. Stream lengths were obtained from the quadrangle map. Reservoir area-capacity data and slopes were developed using survey measurements and constructing topographic contours on the aerial photograph. This data is considered to be adequate for the Phase I inspection; however, the use of the USGS quadrangle and the aerial photograph for the hydrologic studies results in an approximate evaluation of spillway and outlet flood discharge capacity and overtopping potential.

c. Urgency.

(1) Lower Dam (30717): The Phase I inspection indicated serious deficiencies in the condition of the Lower Dam. Seepage and stability analyses should be made to determine the safe maximum level of water for normal operation and for flood conditions. Seepage and stability analyses, and control of seepage and piping through the dam should be given priority.

(2) Upper Dam (31036): The Phase I inspection indicated serious deficiencies in the condition of the Upper Dam. Seepage and stability analyses should be done to determine what level of water can be safely impounded and whether or not construction of an overflow

structure would be required to maintain that level during the PMF. Seepage and stability analyses, control of seepage and piping through the dam, and control of erosion at the enlarged section should be given priority.

d. Necessity for Phase II. No Phase II investigations are recommended for either dam; however, additional investigations are recommended as outlined in Sections 7.2.a. (1), (5) and 7.2.b. (3), (4).

7.2 REMEDIAL MEASURES

The following remedial measures are recommended:

a. Lower Dam (30717).

(1) Control of Seepage and Piping: Seepage and stability analyses should be made to determine the safe maximum level of water for normal operation and for flood conditions. The analyses should lead to specific remedial work that would control seepage and piping of tailings through the dam. These remedial measures should be performed under the direction of a professional engineer experienced in the design and construction of tailings dams.

(2) Drainage of Seepage: Seepage which accumulates at the Lower Dam toe should be permanently drained to remove water which saturates and weakens the foundation soil.

(3) Erosion Protection: Erosion gullies on the Lower Dam and downstream slope of the Lower Dam should be repaired, and erosion protection should be placed on slopes of the dam that are subject to heavy runoff or wave action. Consideration should be given to using structural measures to control surface runoff, such as lined ditches, or curbing and downslope culverts. Access to the lower damsite should be restricted to prevent further erosion damage caused by off-road vehicles.

(4) Plugging of Outlet Pipe: The plan to plug the existing outlet pipe from the Lower Dam should be carried out immediately. This will eliminate a potential conduit for piping of tailings through the dam. Plugging the outlet pipe will have a negligible effect on the discharge capacity at the dam.

(5) Seepage and Stability Analyses: Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of tailings dams. Included in these analyses, computations should be performed with the reservoir water surface in the impoundment set at the maximum pool (PMF) level. The necessary data for these analyses would be obtained from additional investigations. The investigations should consist of subsurface exploration and soil sampling, and a laboratory testing program to obtain the necessary engineering parameters of the dam and foundation materials. These parameters should be used in an engineering study to evaluate the stability for the dam. Concurrent with the exploratory work, ground-

water monitoring wells should be installed in the drill holes to obtain water level data that would be used in the stability studies. Remedial measures to the dam should be based on the results of the stability studies and should be done under the direction of a professional engineer experienced in tailings dam design and construction.

(6) Inspection and Maintenance Program: An inspection and maintenance program should be intitiated. Periodic inspections should be made by qualified personnel to observe the performance of the dam, spillway, and outlet. Observations should include indications of instability, such as cracks in the embankment, sloughing, erosion, sudden settlement, or an increase in the volume or turbidity of seepage. Records of these inspections should be maintained, and all maintenance and remedial measures made to the dam, spillway, and outlet pipe should be documented.

b. Upper Dam (31036).

(1) Control of Seepage and Piping: Specific remedial work should be addressed to controlling active piping of tailings through the Upper Dam. This remedial work should be based on appropriate analyses of this condition and should be performed under the direction of an engineer experienced in the design and construction of tailings dams.

(2) Erosion Protection: Erosion protection should be provided on the dam slopes, abutments, and other areas subject the heavy runoff or wave action. Erosion gullies and scarps on the exterior and interior faces of the embankment along the enlarged section should be repaired, and the method of tailings disposal should be modified to prevent their occurrence.

(3) Overflow Provisions: A more effective barrier around the vertical riser of the outlet pipe should be constructed to insure that the outlet pipe can not become plugged. Seepage and stability studies should be done to determine what level of water can be safely impounded by the Upper Dam and whether or not construction of an overflow structure such as an open channel spillway would be required to maintain that level during the PMF. This overflow structure, if required, should have erosion protection adequate to withstand the peak discharge velocity resulting from the PMF without significant erosion of the spillway or embankment. It should be maintained as the dam is raised and should be modified so that it is always capable of passing the PMF while maintaining a safe level of impounded water. This work should be done under the direction of a professional engineer experienced in the design and construction of tailings dams.

(4) Seepage and Stability Analyses: Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of tailings dams. Included in these analyses, computations should be performed with the water surface in the impoundment set at the maximum pool (PMF) level. The necessary data for these analyses would be obtained from additional investigations. The investigations should consist of subsurface exploration and soil sampling, and

a laboratory testing program to obtain the necessary engineering parameters of the dam and foundation materials. These parameters should be used in an engineering study to evaluate the stability of the dam. Concurrent with the exploratory work, groundwater monitoring wells should be installed in the drill holes to obtain water level data that would be used in the stability studies. Remedial measures to the dam should be based on the results of the stability studies and should be done under the direction of a professional engineer experienced in tailings dam design and construction.

(5) Inspection and Maintenance Program: Although the dam is currently being raised, an inspection and maintenance program should be initiated. Periodic inspections should be made by qualified personnel to observe the performance of the dam and outlet. Observations should include indications of instability, such as cracks in the embankment, sloughing, erosion, sudden settlement, or an increase in the volume or turbidity of seepage. Records of these inspections should be maintained, and all maintenance and remedial measures made to the dam and outlet pipe should be documented.

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

The hydrologic and hydraulic analyses were accomplished by using the computer program "Flood Hydrograph Package, HEC-1, Dam Safety Investigations Version, July 1978". This program was developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The criteria and methodology used are briefly discussed below:

- Probable Maximum Precipitation (PMP) - The 24-hour PMP was obtained from Hydrometeorological Report No. 33. The 6-hour and the 1-hour depth-duration distributions followed Corps of Engineers EM 1110-2-1411 criteria.

- 100-year and/or 10-year storms - The 24-hour storm amounts and distributions were supplied by Corps of Engineers, St. Louis District, Missouri.

- Unit Hydrograph - The Soil Conservation Service (SCS) curvelinear unit hydrograph method was used. Basin lag time was computed by using the SCS Curve Number Method and equation.

- Hydrologic Soil Group, Antecedent Moisture Condition (AMC) and Curve Number (CN) - The predominant hydrologic soil group for the watershed was obtained from an agricultural soil classification map prepared by the University of Missouri Agricultural Experiment Station. For the PMF and floods expressed as a percent of PMF, AMC III conditions were used. For the 100-year and/or 10-year floods, AMC II conditions were assumed. Watershed CN was estimated from field observations and from aerial photos.

- Reservoir Area-Capacity - Areas were measured from U.S.G.S. topographic maps and/or from aerial photographs. Reservoir elevations and corresponding surface areas were input in the computer program, which determined the reservoir capacities by the Conic Method.

- Reservoir and Spillway Flood Routing - The Modified Puls Method was used for all flood routing through the spillway and dam overtopping analyses.

The following pages present the input data listing, the computer program version and its last modification date, together with pertinent computer printouts of results. Definitions of all input and output variable names are presented in the computer program "Users Manual", September 1978, and are not explained herein.

```
A1          INDIAN CREEK MINE DAM MO. NO. 31036 AND 30717
A2          HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3          RATIOS OF PMF
B      200                15                                                           2
B1       5
J        1         5       1
J1     .03       .25      .5      .75        1
K        0  RUNOFF                                                  1
K1  INFLOW FROM UPPER WATERSHED TO POND, ID 31036
M        1         2   .1586                             1                             1
P               25.8     102      120      130
T                                                                  -1      -81                  .1
W2              .106
X      -10       -.1     2.5
K        1  U POND                                                  1
K1  PMF RATIOS ROUTING THROUGH OUTLET PIPE
Y                                   1        1
Y1       1                                                     -986.4       -1
Y4 986.3     986.5   986.6    987.0    987.7    988.0    989.0    991.5    995.0   1000.0
Y5       0       1.4       2      3.1      4.5      4.9      6.2      6.6      7.2      7.9
$A      10        17      28       38       46       52       56       60
$E 986.3       988     990      992      994      996      998     1000
$$ 986.3
$D 998.8
```

```
K       0  RUNOFF                                                          1
K1   INFLOW FROM LOWER WATERSHED TO POND, ID 30717
M       1       2   1.014                                      1                             1
P             25.8       102       120       130
T                                                                         -1      -75                 .05
W2            1.49
X     -10      -.1       2.5
K       2  UP+LOW                                                          1
K1   COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED
K       1  L POND                                                          1
K1   PMF RATIOS ROUTING THROUGH LOWER POND, ID 30717
Y                                           1
Y1      1                                                         -944.8      -1
Y4  944.0     944.8     945.5     946.5     947.9     949.3     950.7     952.1     954.8     957.5
Y5    4.5       4.6        33       141       418       798      1269      1834      3237      5008
$A     28        40        53        62        70        80        86
$E    944       947       950       952       954       956     957.5
$$  944.8
$D  957.5
K      99
A
A
```

```
*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
*********************************

RUN  DATE* 79/10/31.
     TIME* 15.30.53.

                          INDIAN CREEK MINE DAM MO. NO. 31036 AND 30717
                          HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
                          RATIOS OF PMF

                                             JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         200        0       15        0        0        0        0        0        2        0
                                  JOPER      NWT    LROPT    TRACE
                                      5        0        0        0

                                   MULTI-PLAN ANALYSES TO BE PERFORMED
                                         NPLAN= 1 NRTIO= 4 LRTIO= 1
           RTIOS= .03  .25    .50    .75   1.00


       **********        **********        **********        **********        **********

                                        SUB-AREA RUNOFF COMPUTATION

         INFLOW FROM UPPER WATERSHED TO POND, ID 31036

                       ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                      RUNOFF        0        0        0        0        0        1        0        0

                                             HYDROGRAPH DATA
         IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
             1        2      .16     0.00      .16     1.00    0.000        0        1        0

                                               PRECIP DATA
                  SPFE      PMS       R6      R12      R24      R48      R72      R96
                  0.00    25.80   102.00   120.00   130.00     0.00     0.00     0.00

                                                LOSS DATA
       LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
           0     0.00     0.00     1.00     0.00     0.00     1.00    -1.00   -81.00     0.00      .10

         CURVE NO =  -81.00  WETNESS =   -1.00  EFFECT CN =   81.00

                                          UNIT HYDROGRAPH DATA
                                      TC=  0.00     LAG=    .11

                                             RECESSION DATA
                               STRTQ=  -10.00    QRCSN=    -.10    RTIOR= 2.50

         TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

        UNIT HYDROGRAPH  5 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=    .11  VOL= 1.00
```

304. 85. 17. 3. 0.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.15	1	.04	.00	.04	3.	1.02	1.15	101	0.00	0.00	0.00	17.
1.01	.30	2	.04	.00	.04	3.	1.02	1.30	102	0.00	0.00	0.00	15.
1.01	.45	3	.04	.00	.04	3.	1.02	1.45	103	0.00	0.00	0.00	14.
1.01	1.00	4	.04	.00	.04	3.	1.02	2.00	104	0.00	0.00	0.00	13.
1.01	1.15	5	.04	.00	.04	3.	1.02	2.15	105	0.00	0.00	0.00	12.
1.01	1.30	6	.04	.00	.04	3.	1.02	2.30	106	0.00	0.00	0.00	11.
1.01	1.45	7	.04	.00	.04	3.	1.02	2.45	107	0.00	0.00	0.00	10.
1.01	2.00	8	.04	.00	.04	3.	1.02	3.00	108	0.00	0.00	0.00	9.
1.01	2.15	9	.04	.00	.04	2.	1.02	3.15	109	0.00	0.00	0.00	8.
1.01	2.30	10	.04	.00	.04	2.	1.02	3.30	110	0.00	0.00	0.00	7.
1.01	2.45	11	.04	.00	.04	2.	1.02	3.45	111	0.00	0.00	0.00	7.
1.01	3.00	12	.04	.01	.04	3.	1.02	4.00	112	0.00	0.00	0.00	6.
1.01	3.15	13	.04	.01	.04	3.	1.02	4.15	113	0.00	0.00	0.00	6.
1.01	3.30	14	.04	.01	.04	3.	1.02	4.30	114	0.00	0.00	0.00	5.
1.01	3.45	15	.04	.01	.03	4.	1.02	4.45	115	0.00	0.00	0.00	5.
1.01	4.00	16	.04	.01	.03	4.	1.02	5.00	116	0.00	0.00	0.00	4.
1.01	4.15	17	.04	.01	.03	5.	1.02	5.15	117	0.00	0.00	0.00	4.
1.01	4.30	18	.04	.01	.03	5.	1.02	5.30	118	0.00	0.00	0.00	4.
1.01	4.45	19	.04	.01	.03	6.	1.02	5.45	119	0.00	0.00	0.00	3.
1.01	5.00	20	.04	.01	.03	6.	1.02	6.00	120	0.00	0.00	0.00	3.
1.01	5.15	21	.04	.02	.03	6.	1.02	6.15	121	0.00	0.00	0.00	3.
1.01	5.30	22	.04	.02	.03	7.	1.02	6.30	122	0.00	0.00	0.00	2.
1.01	5.45	23	.04	.02	.03	7.	1.02	6.45	123	0.00	0.00	0.00	2.
1.01	6.00	24	.04	.02	.03	7.	1.02	7.00	124	0.00	0.00	0.00	2.
1.01	6.15	25	.19	.09	.11	29.	1.02	7.15	125	0.00	0.00	0.00	2.
1.01	6.30	26	.19	.10	.09	38.	1.02	7.30	126	0.00	0.00	0.00	2.
1.01	6.45	27	.19	.11	.08	44.	1.02	7.45	127	0.00	0.00	0.00	2.
1.01	7.00	28	.19	.12	.07	48.	1.02	8.00	128	0.00	0.00	0.00	1.
1.01	7.15	29	.19	.13	.07	51.	1.02	8.15	129	0.00	0.00	0.00	1.
1.01	7.30	30	.19	.13	.06	54.	1.02	8.30	130	0.00	0.00	0.00	1.
1.01	7.45	31	.19	.14	.06	56.	1.02	8.45	131	0.00	0.00	0.00	1.
1.01	8.00	32	.19	.14	.05	58.	1.02	9.00	132	0.00	0.00	0.00	1.
1.01	8.15	33	.19	.15	.05	60.	1.02	9.15	133	0.00	0.00	0.00	1.
1.01	8.30	34	.19	.15	.04	61.	1.02	9.30	134	0.00	0.00	0.00	1.
1.01	8.45	35	.19	.15	.04	63.	1.02	9.45	135	0.00	0.00	0.00	1.
1.01	9.00	36	.19	.16	.04	64.	1.02	10.00	136	0.00	0.00	0.00	1.
1.01	9.15	37	.19	.16	.03	65.	1.02	10.15	137	0.00	0.00	0.00	1.
1.01	9.30	38	.19	.16	.03	66.	1.02	10.30	138	0.00	0.00	0.00	1.
1.01	9.45	39	.19	.16	.03	67.	1.02	10.45	139	0.00	0.00	0.00	1.
1.01	10.00	40	.19	.17	.03	68.	1.02	11.00	140	0.00	0.00	0.00	0.
1.01	10.15	41	.19	.17	.03	68.	1.02	11.15	141	0.00	0.00	0.00	0.
1.01	10.30	42	.19	.17	.02	69.	1.02	11.30	142	0.00	0.00	0.00	0.
1.01	10.45	43	.19	.17	.02	70.	1.02	11.45	143	0.00	0.00	0.00	0.
1.01	11.00	44	.19	.17	.02	70.	1.02	12.00	144	0.00	0.00	0.00	0.
1.01	11.15	45	.19	.17	.02	71.	1.02	12.15	145	0.00	0.00	0.00	0.
1.01	11.30	46	.19	.17	.02	71.	1.02	12.30	146	0.00	0.00	0.00	0.
1.01	11.45	47	.19	.18	.02	72.	1.02	12.45	147	0.00	0.00	0.00	0.
1.01	12.00	48	.19	.18	.02	72.	1.02	13.00	148	0.00	0.00	0.00	0.
1.01	12.15	49	.66	.61	.05	203.	1.02	13.15	149	0.00	0.00	0.00	0.
1.01	12.30	50	.66	.61	.04	241.	1.02	13.30	150	0.00	0.00	0.00	0.
1.01	12.45	51	.66	.62	.04	251.	1.02	13.45	151	0.00	0.00	0.00	0.
1.01	13.00	52	.66	.62	.03	255.	1.02	14.00	152	0.00	0.00	0.00	0.
1.01	13.15	53	.79	.75	.03	295.	1.02	14.15	153	0.00	0.00	0.00	0.
1.01	13.30	54	.79	.76	.03	308.	1.02	14.30	154	0.00	0.00	0.00	0.
1.01	13.45	55	.79	.76	.03	311.	1.02	14.45	155	0.00	0.00	0.00	0.

1.01	14.00	56	.79	.77	.02	313.	1.02	15.00	156	0.00	0.00	0.00	0.
1.01	14.15	57	.99	.96	.03	373.	1.02	15.15	157	0.00	0.00	0.00	0.
1.01	14.30	58	.99	.96	.02	390.	1.02	15.30	158	0.00	0.00	0.00	0.
1.01	14.45	59	.99	.97	.02	395.	1.02	15.45	159	0.00	0.00	0.00	0.
1.01	15.00	60	.99	.97	.02	396.	1.02	16.00	160	0.00	0.00	0.00	0.
1.01	15.15	61	1.00	.98	.02	401.	1.02	16.15	161	0.00	0.00	0.00	0.
1.01	15.30	62	2.00	1.97	.03	703.	1.02	16.30	162	0.00	0.00	0.00	0.
1.01	15.45	63	5.60	5.55	.05	1874.	1.02	16.45	163	0.00	0.00	0.00	0.
1.01	16.00	64	1.40	1.39	.01	931.	1.02	17.00	164	0.00	0.00	0.00	0.
1.01	16.15	65	.92	.92	.01	496.	1.02	17.15	165	0.00	0.00	0.00	0.
1.01	16.30	66	.92	.92	.01	398.	1.02	17.30	166	0.00	0.00	0.00	0.
1.01	16.45	67	.92	.92	.01	376.	1.02	17.45	167	0.00	0.00	0.00	0.
1.01	17.00	68	.92	.92	.00	375.	1.02	18.00	168	0.00	0.00	0.00	0.
1.01	17.15	69	.72	.72	.00	315.	1.02	18.15	169	0.00	0.00	0.00	0.
1.01	17.30	70	.72	.72	.00	299.	1.02	18.30	170	0.00	0.00	0.00	0.
1.01	17.45	71	.72	.72	.00	295.	1.02	18.45	171	0.00	0.00	0.00	0.
1.01	18.00	72	.72	.72	.00	295.	1.02	19.00	172	0.00	0.00	0.00	0.
1.01	18.15	73	.06	.06	.00	180.	1.02	19.15	173	0.00	0.00	0.00	0.
1.01	18.30	74	.06	.06	.00	164.	1.02	19.30	174	0.00	0.00	0.00	0.
1.01	18.45	75	.06	.06	.00	150.	1.02	19.45	175	0.00	0.00	0.00	0.
1.01	19.00	76	.06	.06	.00	137.	1.02	20.00	176	0.00	0.00	0.00	0.
1.01	19.15	77	.06	.06	.00	125.	1.02	20.15	177	0.00	0.00	0.00	0.
1.01	19.30	78	.06	.06	.00	114.	1.02	20.30	178	0.00	0.00	0.00	0.
1.01	19.45	79	.06	.06	.00	104.	1.02	20.45	179	0.00	0.00	0.00	0.
1.01	20.00	80	.06	.06	.00	95.	1.02	21.00	180	0.00	0.00	0.00	0.
1.01	20.15	81	.06	.06	.00	86.	1.02	21.15	181	0.00	0.00	0.00	0.
1.01	20.30	82	.06	.06	.00	79.	1.02	21.30	182	0.00	0.00	0.00	0.
1.01	20.45	83	.06	.06	.00	72.	1.02	21.45	183	0.00	0.00	0.00	0.
1.01	21.00	84	.06	.06	.00	66.	1.02	22.00	184	0.00	0.00	0.00	0.
1.01	21.15	85	.06	.06	.00	60.	1.02	22.15	185	0.00	0.00	0.00	0.
1.01	21.30	86	.06	.06	.00	55.	1.02	22.30	186	0.00	0.00	0.00	0.
1.01	21.45	87	.06	.06	.00	50.	1.02	22.45	187	0.00	0.00	0.00	0.
1.01	22.00	88	.06	.06	.00	45.	1.02	23.00	188	0.00	0.00	0.00	0.
1.01	22.15	89	.06	.06	.00	42.	1.02	23.15	189	0.00	0.00	0.00	0.
1.01	22.30	90	.06	.06	.00	38.	1.02	23.30	190	0.00	0.00	0.00	0.
1.01	22.45	91	.06	.06	.00	35.	1.02	23.45	191	0.00	0.00	0.00	0.
1.01	23.00	92	.06	.06	.00	32.	1.03	0.00	192	0.00	0.00	0.00	0.
1.01	23.15	93	.06	.06	.00	29.	1.03	.15	193	0.00	0.00	0.00	0.
1.01	23.30	94	.06	.06	.00	26.	1.03	.30	194	0.00	0.00	0.00	0.
1.01	23.45	95	.06	.06	.00	26.	1.03	.45	195	0.00	0.00	0.00	0.
1.02	0.00	96	.06	.06	.00	26.	1.03	1.00	196	0.00	0.00	0.00	0.
1.02	.15	97	0.00	0.00	0.00	24.	1.03	1.15	197	0.00	0.00	0.00	0.
1.02	.30	98	0.00	0.00	0.00	22.	1.03	1.30	198	0.00	0.00	0.00	0.
1.02	.45	99	0.00	0.00	0.00	20.	1.03	1.45	199	0.00	0.00	0.00	0.
1.02	1.00	100	0.00	0.00	0.00	18.	1.03	2.00	200	0.00	0.00	0.00	0.
									SUM	33.54	31.15	2.39	14150.
										(852.)	(791.)	(61.)	(400.68)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1874.	437.	146.	71.	14143.
CMS	53.	12.	4.	2.	400.
INCHES		25.61	34.30	34.56	34.56
MM		650.45	871.25	877.93	877.93
AC-FT		216.	290.	292.	292.
THOUS CU M		267.	358.	360.	360.

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**********          **********          **********          **********          **********

                                  HYDROGRAPH ROUTING

            PMF RATIOS ROUTING THROUGH OUTLET PIPE

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        U POND      1       0       0       0       0       1       0       0
                                                  ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP           LSTR
                   0.0   0.000    0.00       1       1       0       0              0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000   -986.      -1

 STAGE         986.30     986.50     986.60     987.00     987.70     988.00     989.00     991.50     995.00    1000.00

  FLOW           0.00       1.40       2.00       3.10       4.50       4.90       6.20       6.60       7.20       7.90

SURFACE AREA=        10.       17.       28.       38.       46.       52.       56.       60.

    CAPACITY=         0.       23.       67.      133.      217.      315.      423.      539.

   ELEVATION=       986.      988.      990.      992.      994.      996.      998.     1000.

                    CREL   SPWID    COQW    EXPW   ELEVL    COOL   CAREA    EXPL
                   986.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                                DAM DATA
                                       TOPEL    COQD    EXPD   DAMWID
                                       998.8     0.0     0.0       0.


                                   STATION U POND, PLAN 1, RATIO 5

                                  END-OF-PERIOD HYDROGRAPH ORDINATES

                                               OUTFLOW
            1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
            1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
            1.        1.        2.        2.        2.        2.        2.        2.        3.        3.
            3.        3.        3.        4.        4.        4.        4.        4.        4.        5.
            5.        5.        5.        5.        5.        5.        5.        5.        6.        6.
            6.        6.        6.        6.        6.        6.        6.        6.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
            7.        7.        7.        7.        7.        7.        7.        7.        7.        7.
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**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

         INFLOW FROM LOWER WATERSHED TO POND, ID 30717

                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   RUNOFF       0       0       0       0       0       1       0       0

                                      HYDROGRAPH DATA
         IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
             1       2    1.01    0.00    1.01    1.00   0.000       0       1       0

                                      PRECIP DATA
                  SPFE     PMS      R6     R12     R24     R48     R72     R96
                  0.00   25.80  102.00  120.00  130.00    0.00    0.00    0.00

                                       LOSS DATA
       LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
           0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -75.00    0.00     .05

         CURVE NO =  -75.00  WETNESS =   -1.00  EFFECT CN =   75.00

                                  UNIT HYDROGRAPH DATA
                              TC=  0.00     LAG=  1.49

                                     RECESSION DATA
                    STRTQ=  -10.00     QRCSN=    -.10    RTIOR= 2.50

        UNIT HYDROGRAPH 32 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   1.49  VOL= 1.00
       21.       61.      125.      209.      273.      301.      301.      274.      238.      189.
      139.      108.       84.       66.       52.       40.       31.       24.       19.       14.
       11.        9.        7.        5.        4.        3.        3.        2.        2.        1.
        1.        0.

  0                                          END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS     COMP Q

 1.01    .15       1    .04    .00    .04       9.        1.02   1.15     101   0.00   0.00   0.00      131.
 1.01    .30       2    .04    .00    .04       9.        1.02   1.30     102   0.00   0.00   0.00      120.
 1.01    .45       3    .04    .00    .04       8.        1.02   1.45     103   0.00   0.00   0.00      109.
 1.01   1.00       4    .04    .00    .04       8.        1.02   2.00     104   0.00   0.00   0.00      100.
 1.01   1.15       5    .04    .00    .04       8.        1.02   2.15     105   0.00   0.00   0.00       91.
 1.01   1.30       6    .04    .00    .04       8.        1.02   2.30     106   0.00   0.00   0.00       83.
 1.01   1.45       7    .04    .00    .04       8.        1.02   2.45     107   0.00   0.00   0.00       76.
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1.01	2.00	8	.04	.00	.04	8.	1.02	3.00	108	0.00	0.00	0.00	69.
1.01	2.15	9	.04	.00	.04	8.	1.02	3.15	109	0.00	0.00	0.00	63.
1.01	2.30	10	.04	.00	.04	8.	1.02	3.30	110	0.00	0.00	0.00	58.
1.01	2.45	11	.04	.00	.04	8.	1.02	3.45	111	0.00	0.00	0.00	53.
1.01	3.00	12	.04	.00	.04	8.	1.02	4.00	112	0.00	0.00	0.00	48.
1.01	3.15	13	.04	.00	.04	8.	1.02	4.15	113	0.00	0.00	0.00	44.
1.01	3.30	14	.04	.00	.04	8.	1.02	4.30	114	0.00	0.00	0.00	40.
1.01	3.45	15	.04	.00	.04	8.	1.02	4.45	115	0.00	0.00	0.00	36.
1.01	4.00	16	.04	.00	.04	8.	1.02	5.00	116	0.00	0.00	0.00	33.
1.01	4.15	17	.04	.00	.04	8.	1.02	5.15	117	0.00	0.00	0.00	30.
1.01	4.30	18	.04	.00	.04	8.	1.02	5.30	118	0.00	0.00	0.00	28.
1.01	4.45	19	.04	.01	.04	8.	1.02	5.45	119	0.00	0.00	0.00	25.
1.01	5.00	20	.04	.01	.04	8.	1.02	6.00	120	0.00	0.00	0.00	23.
1.01	5.15	21	.04	.01	.04	8.	1.02	6.15	121	0.00	0.00	0.00	21.
1.01	5.30	22	.04	.01	.04	9.	1.02	6.30	122	0.00	0.00	0.00	19.
1.01	5.45	23	.04	.01	.03	10.	1.02	6.45	123	0.00	0.00	0.00	17.
1.01	6.00	24	.04	.01	.03	12.	1.02	7.00	124	0.00	0.00	0.00	16.
1.01	6.15	25	.19	.05	.14	14.	1.02	7.15	125	0.00	0.00	0.00	15.
1.01	6.30	26	.19	.07	.13	19.	1.02	7.30	126	0.00	0.00	0.00	13.
1.01	6.45	27	.19	.08	.12	27.	1.02	7.45	127	0.00	0.00	0.00	12.
1.01	7.00	28	.19	.09	.11	40.	1.02	8.00	128	0.00	0.00	0.00	11.
1.01	7.15	29	.19	.10	.10	58.	1.02	8.15	129	0.00	0.00	0.00	10.
1.01	7.30	30	.19	.10	.09	80.	1.02	8.30	130	0.00	0.00	0.00	9.
1.01	7.45	31	.19	.11	.08	104.	1.02	8.45	131	0.00	0.00	0.00	8.
1.01	8.00	32	.19	.12	.08	130.	1.02	9.00	132	0.00	0.00	0.00	8.
1.01	8.15	33	.19	.12	.07	157.	1.02	9.15	133	0.00	0.00	0.00	7.
1.01	8.30	34	.19	.13	.07	182.	1.02	9.30	134	0.00	0.00	0.00	6.
1.01	8.45	35	.19	.13	.06	205.	1.02	9.45	135	0.00	0.00	0.00	6.
1.01	9.00	36	.19	.14	.06	227.	1.02	10.00	136	0.00	0.00	0.00	5.
1.01	9.15	37	.19	.14	.05	248.	1.02	10.15	137	0.00	0.00	0.00	5.
1.01	9.30	38	.19	.14	.05	266.	1.02	10.30	138	0.00	0.00	0.00	4.
1.01	9.45	39	.19	.15	.05	285.	1.02	10.45	139	0.00	0.00	0.00	4.
1.01	10.00	40	.19	.15	.05	299.	1.02	11.00	140	0.00	0.00	0.00	4.
1.01	10.15	41	.19	.15	.04	313.	1.02	11.15	141	0.00	0.00	0.00	3.
1.01	10.30	42	.19	.15	.04	326.	1.02	11.30	142	0.00	0.00	0.00	3.
1.01	10.45	43	.19	.15	.04	338.	1.02	11.45	143	0.00	0.00	0.00	3.
1.01	11.00	44	.19	.16	.04	349.	1.02	12.00	144	0.00	0.00	0.00	3.
1.01	11.15	45	.19	.16	.03	359.	1.02	12.15	145	0.00	0.00	0.00	2.
1.01	11.30	46	.19	.16	.03	368.	1.02	12.30	146	0.00	0.00	0.00	2.
1.01	11.45	47	.19	.16	.03	377.	1.02	12.45	147	0.00	0.00	0.00	2.
1.01	12.00	48	.19	.16	.03	384.	1.02	13.00	148	0.00	0.00	0.00	2.
1.01	12.15	49	.66	.57	.09	400.	1.02	13.15	149	0.00	0.00	0.00	2.
1.01	12.30	50	.66	.58	.08	431.	1.02	13.30	150	0.00	0.00	0.00	1.
1.01	12.45	51	.66	.59	.07	488.	1.02	13.45	151	0.00	0.00	0.00	1.
1.01	13.00	52	.66	.60	.06	579.	1.02	14.00	152	0.00	0.00	0.00	1.
1.01	13.15	53	.79	.72	.06	700.	1.02	14.15	153	0.00	0.00	0.00	1.
1.01	13.30	54	.79	.73	.06	839.	1.02	14.30	154	0.00	0.00	0.00	1.
1.01	13.45	55	.79	.74	.05	988.	1.02	14.45	155	0.00	0.00	0.00	1.
1.01	14.00	56	.79	.75	.04	1138.	1.02	15.00	156	0.00	0.00	0.00	1.
1.01	14.15	57	.99	.94	.05	1286.	1.02	15.15	157	0.00	0.00	0.00	1.
1.01	14.30	58	.99	.94	.04	1426.	1.02	15.30	158	0.00	0.00	0.00	1.
1.01	14.45	59	.99	.95	.04	1559.	1.02	15.45	159	0.00	0.00	0.00	1.
1.01	15.00	60	.99	.95	.03	1691.	1.02	16.00	160	0.00	0.00	0.00	1.
1.01	15.15	61	1.00	.97	.03	1821.	1.02	16.15	161	0.00	0.00	0.00	1.
1.01	15.30	62	2.00	1.95	.05	1964.	1.02	16.30	162	0.00	0.00	0.00	0.
1.01	15.45	63	5.60	5.49	.11	2207.	1.02	16.45	163	0.00	0.00	0.00	0.
1.01	16.00	64	1.40	1.38	.02	2558.	1.02	17.00	164	0.00	0.00	0.00	0.
1.01	16.15	65	.92	.91	.01	3028.	1.02	17.15	165	0.00	0.00	0.00	0.
1.01	16.30	66	.92	.91	.01	3562.	1.02	17.30	166	0.00	0.00	0.00	0.
1.01	16.45	67	.92	.91	.01	3957.	1.02	17.45	167	0.00	0.00	0.00	0.

1.01	17.00	68	.92	.91	.01	4137.	1.02	18.00	168	0.00	0.00	0.00	0.
1.01	17.15	69	.72	.72	.01	4132.	1.02	18.15	169	0.00	0.00	0.00	0.
1.01	17.30	70	.72	.72	.01	3972.	1.02	18.30	170	0.00	0.00	0.00	0.
1.01	17.45	71	.72	.72	.01	3728.	1.02	18.45	171	0.00	0.00	0.00	0.
1.01	18.00	72	.72	.72	.01	3400.	1.02	19.00	172	0.00	0.00	0.00	0.
1.01	18.15	73	.06	.06	.00	3055.	1.02	19.15	173	0.00	0.00	0.00	0.
1.01	18.30	74	.06	.06	.00	2770.	1.02	19.30	174	0.00	0.00	0.00	0.
1.01	18.45	75	.06	.06	.00	2490.	1.02	19.45	175	0.00	0.00	0.00	0.
1.01	19.00	76	.06	.06	.00	2198.	1.02	20.00	176	0.00	0.00	0.00	0.
1.01	19.15	77	.06	.06	.00	1887.	1.02	20.15	177	0.00	0.00	0.00	0.
1.01	19.30	78	.06	.06	.00	1586.	1.02	20.30	178	0.00	0.00	0.00	0.
1.01	19.45	79	.06	.06	.00	1310.	1.02	20.45	179	0.00	0.00	0.00	0.
1.01	20.00	80	.06	.06	.00	1069.	1.02	21.00	180	0.00	0.00	0.00	0.
1.01	20.15	81	.06	.06	.00	866.	1.02	21.15	181	0.00	0.00	0.00	0.
1.01	20.30	82	.06	.06	.00	705.	1.02	21.30	182	0.00	0.00	0.00	0.
1.01	20.45	83	.06	.06	.00	586.	1.02	21.45	183	0.00	0.00	0.00	0.
1.01	21.00	84	.06	.06	.00	495.	1.02	22.00	184	0.00	0.00	0.00	0.
1.01	21.15	85	.06	.06	.00	421.	1.02	22.15	185	0.00	0.00	0.00	0.
1.01	21.30	86	.06	.06	.00	382.	1.02	22.30	186	0.00	0.00	0.00	0.
1.01	21.45	87	.06	.06	.00	348.	1.02	22.45	187	0.00	0.00	0.00	0.
1.01	22.00	88	.06	.06	.00	318.	1.02	23.00	188	0.00	0.00	0.00	0.
1.01	22.15	89	.06	.06	.00	290.	1.02	23.15	189	0.00	0.00	0.00	0.
1.01	22.30	90	.06	.06	.00	265.	1.02	23.30	190	0.00	0.00	0.00	0.
1.01	22.45	91	.06	.06	.00	242.	1.02	23.45	191	0.00	0.00	0.00	0.
1.01	23.00	92	.06	.06	.00	220.	1.03	0.00	192	0.00	0.00	0.00	0.
1.01	23.15	93	.06	.06	.00	201.	1.03	.15	193	0.00	0.00	0.00	0.
1.01	23.30	94	.06	.06	.00	188.	1.03	.30	194	0.00	0.00	0.00	0.
1.01	23.45	95	.06	.06	.00	182.	1.03	.45	195	0.00	0.00	0.00	0.
1.02	0.00	96	.06	.06	.00	178.	1.03	1.00	196	0.00	0.00	0.00	0.
1.02	.15	97	0.00	0.00	0.00	174.	1.03	1.15	197	0.00	0.00	0.00	0.
1.02	.30	98	0.00	0.00	0.00	168.	1.03	1.30	198	0.00	0.00	0.00	0.
1.02	.45	99	0.00	0.00	0.00	158.	1.03	1.45	199	0.00	0.00	0.00	0.
1.02	1.00	100	0.00	0.00	0.00	144.	1.03	2.00	200	0.00	0.00	0.00	0.
									SUM	33.54	30.03	3.51	79733.
										(852.)	(763.)	(89.)	(2257.79)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4137.	2534.	826.	399.	79734.
CMS	117.	72.	23.	11.	2258.
INCHES		23.25	30.31	30.48	30.48
MM		590.57	769.97	774.14	774.14
AC-FT		1257.	1639.	1647.	1647.
THOUS CU M		1550.	2021.	2032.	2032.

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UP+LOW	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT UP+LOW PLAN 1 RTIO 5

10.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
10.	11.	12.	13.	16.	21.	29.	42.	60.	83.
108.	134.	160.	185.	209.	231.	252.	271.	288.	304.
318.	331.	343.	354.	364.	374.	382.	39[illegible].	405.	437.
494.	585.	707.	846.	994.	1144.	1292.	1433.	1565.	1698.
1828.	1971.	2214.	2565.	3035.	3568.	3964.	4144.	4139.	3979.
3735.	3407.	3062.	2777.	2497.	2205.	1894.	1593.	1317.	1076.
873.	713.	593.	500.	428.	389.	356.	325.	297.	272.
249.	228.	208.	195.	189.	185.	181.	175.	165.	151.
139.	127.	117.	107.	98.	90.	83.	76.	70.	65.
60.	55.	51.	47.	44.	40.	38.	35.	32.	30.
28.	26.	25.	23.	22.	21.	19.	18.	17.	16.
16.	15.	14.	14.	13.	13.	12.	12.	11.	11.
11.	10.	10.	10.	10.	9.	9.	9.	9.	9.
9.	8.	8.	8.	8.	8.	8.	8.	8.	8.
8.	8.	8.	8.	8.	8.	8.	8.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.

....

HYDROGRAPH ROUTING

PMF RATIOS ROUTING THROUGH LOWER POND, ID 30717

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
L POND	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-945.	-1

STAGE	944.00	944.80	945.50	946.50	947.90	949.30	950.70	952.10	954.80	957.50
FLOW	4.50	4.60	33.00	141.00	418.00	798.00	1269.00	1834.00	3237.00	5008.00

SURFACE AREA=	28.	40.	53.	62.	70.	80.	86.
CAPACITY=	0.	101.	241.	355.	487.	637.	762.
ELEVATION=	944.	947.	950.	952.	954.	956.	957.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
944.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
957.5	0.0	0.0	0.

STATION L POND, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

5.	5.	5.	5.	5.	5.	5.	5.	6.	6.
6.	6.	6.	6.	6.	6.	6.	5.	6.	6.
7.	7.	7.	7.	7.	7.	8.	9.	10.	11.
14.	16.	20.	24.	28.	33.	45.	54.	72.	86.
100.	113.	126.	139.	160.	181.	200.	217.	236.	254.
274.	300.	332.	373.	424.	500.	584.	671.	762.	867.
980.	1093.	1213.	1365.	1557.	1782.	2079.	2379.	2638.	2842.
2985.	3067.	3090.	3066.	3007.	2915.	2792.	2641.	2467.	2277.
2079.	1878.	1714.	1563.	1417.	1279.	1171.	1071.	977.	893.
809.	745.	688.	634.	584.	538.	497.	459.	424.	399.
373.	354.	332.	312.	292.	273.	255.	238.	222.	207.
193.	179.	166.	155.	143.	137.	131.	126.	120.	115.
113.	105.	100.	96.	91.	87.	83.	79.	76.	72.
69.	65.	62.	59.	56.	54.	51.	49.	46.	44.
42.	40.	38.	36.	35.	33.	32.	32.	31.	31.
30.	30.	29.	29.	28.	28.	27.	27.	26.	26.
25.	25.	24.	24.	24.	23.	23.	22.	22.	22.
21.	21.	21.	20.	20.	20.	19.	19.	19.	18.
18.	18.	18.	17.	17.	17.	17.	16.	16.	15.
16.	15.	15.	15.	15.	15.	14.	14.	14.	14.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .03	RATIO 2 .25	RATIO 3 .50	RATIO 4 .75	RATIO 5 1.00
				RATIOS APPLIED TO FLOWS				
HYDROGRAPH AT	RUNOFF	.16	1	56.	469.	937.	1406.	1874.
	(	.41)	(	1.59)(	13.27)(	26.53)(	39.80)(	53.07)(
ROUTED TO	U POND	.16	1	3.	6.	7.	7.	7.
	(	.41)	(	.08)(	.18)(	.19)(	.20)(	.21)(
HYDROGRAPH AT	RUNOFF	1.01	1	124.	1034.	2068.	3103.	4137.
	(	2.63)	(	3.51)(	29.29)(	58.57)(	87.86)(	117.14)(
2 COMBINED	UP+LOW	1.17	1	127.	1040.	2075.	3109.	4144.
	(	3.04)	(	3.59)(	29.46)(	58.76)(	88.05)(	117.34)(
ROUTED TO	L POND	1.17	1	48.	694.	1471.	2295.	3090.
	(	3.04)	(	1.37)(	19.64)(	41.65)(	64.98)(	87.49)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	986.40	986.30	998.80
STORAGE	1.	0.	468.
OUTFLOW	1.	0.	8.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.03	986.92	0.00	7.	3.	0.00	20.00	0.00
.25	989.93	0.00	65.	6.	0.00	24.00	0.00
.50	992.09	0.00	136.	7.	0.00	25.75	0.00
.75	993.81	0.00	208.	7.	0.00	26.75	0.00
1.00	995.32	0.00	280.	7.	0.00	27.50	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	944.80	944.80	957.50
STORAGE	24.	24.	762.
OUTFLOW	5.	5.	5008.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.03	945.64	0.00	51.	48.	0.00	19.50	0.00
.25	948.92	0.00	186.	694.	0.00	18.50	0.00
.50	951.20	0.00	307.	1471.	0.00	18.25	0.00
.75	952.99	0.00	418.	2295.	0.00	18.25	0.00
1.00	954.52	0.00	524.	3090.	0.00	18.25	0.00

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A1         INDIAN CREEK MINE DAM MO. NO. 31036 AND 30717
A2         HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3         100 YEAR FLOOD
B      100              30                                        2
B1       5
J        1       1       1
J1       1
K        0  INFLOW                                1
K1   RUNOFF FROM UPPER WATERSHED TO POND, #31036, SULLIVAN PRECIP. 30 MIN. INCR.
M        0       2   .1566
O       48
O1    .042    .042    .042    .042    .042    .042    .042    .042    .042    .042
O1    .042    .042    .084    .084    .084    .084    .084    .084    .132    .132
O1    .132    .186    .366   1.449   1.853    .366    .186    .132    .132    .132
O1    .084    .084    .084    .084    .084    .084    .042    .042    .042    .042
O1    .042    .042    .042    .042    .042    .042    .042    .042
T                                                     -1     -64              .1
W2             .17
X      -10     -.1     2.5
K        1  U POND                                1
K1   100-YR FLOOD ROUTING THROUGH OUTLET PIPE
Y                                1       1
Y1       1                                        -986.4      -1
Y4   986.3   986.5   986.6   987.0   987.7   988.0   989.0   991.5   995.0  1000.0
Y5       0     1.4       2     3.1     4.5     4.9     6.2     6.6     7.2     7.9
$A      10      17      28      38      46      52      56      60
$E   986.3     988     990     992     994     996     998    1000
$$   986.3
$D   998.8
K        0  RUNOFF                                1
K1   INFLOW FROM LOWER WATERSHED TO DAM NO. 30717, SULLIVAN PRECIP. 30 MIN. INCR.
M        0       2   1.014
O      -48
T                                                     -1     -57             .05
W2             2.4
X      -10     -.1     2.5
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K       2  UP+LOW                                                  1
K1   COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED
K       1  L POND                                                  1
K1   100-YR FLOOD ROUTING THROUGH LOWER POND
Y                                      1
Y1      1                                            -944.8      -1
Y4 944.0     944.8     945.5     946.5     947.9     949.3     950.7     952.1     954.8     957.5
Y5   4.5       4.6        33       141       418       798      1269      1834      3237      5008
$A    28        40        53        62        70        80        86
$E   944       947       950       952       954       956     957.5
$$ 944.8
$D 957.5
K      99
A
A
A
A
A
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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE* 79/11/02.
     TIME* 09.17.50.


                    INDIAN CREEK MINE DAM MO. NO. 31036 AND 30717
                    HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
                    100 YEAR FLOOD

                              JOB SPECIFICATION
     NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
    100        0       30        0        0        0        0        0        2        0
                             JOPER      NWT    LRUPT    TRACE
                                 5        0        0        0

                         MULTI-PLAN ANALYSES TO BE PERFORMED
                               NPLAN= 1 NRTIO= 1 LRTIO= 1
    RTIOS=    1.00


**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

    RUNOFF FROM UPPER WATERSHED TO POND, #31036, SULLIVAN PRECIP. 30 MIN. INCR.

               ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
              INFLOW        0        0        0        0        0        1        0        0

                                     HYDROGRAPH DATA
    IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
        0        2      .16     0.00      .16     0.00    0.000        0        0        0

                                      PRECIP DATA
                               NP    STORM      DAJ      DAK
                               48     0.00     0.00     0.00
                                    PRECIP PATTERN
     .04      .04      .04      .04      .04      .04      .04      .04      .04      .04
     .04      .04      .08      .08      .08      .08      .08      .08      .13      .13
     .13      .19      .37     1.45     1.85      .37      .19      .13      .13      .13
     .08      .08      .08      .08      .08      .08      .04      .04      .04      .04
     .04      .04      .04      .04      .04      .04      .04      .04

                                       LOSS DATA
   LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
       0     0.00     0.00     1.00     0.00     0.00     1.00    -1.00   -64.00     0.00      .10

      CURVE NO =  -64.00  WETNESS =   -1.00  EFFECT CN =   64.00

                                 UNIT HYDROGRAPH DATA
                             TC=  0.00     LAG=   .17
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RECESSION DATA
STRTQ= -10.00 QRCSN= -.10 RTIOR= 2.50

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00
152. 43. 8. 2. 0.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.04	.00	.04	2.	1.02	1.30	51	0.00	0.00	0.00	5.
1.01	1.00	2	.04	.00	.04	2.	1.02	2.00	52	0.00	0.00	0.00	5.
1.01	1.30	3	.04	.00	.04	2.	1.02	2.30	53	0.00	0.00	0.00	4.
1.01	2.00	4	.04	.00	.04	2.	1.02	3.00	54	0.00	0.00	0.00	4.
1.01	2.30	5	.04	.00	.04	2.	1.02	3.30	55	0.00	0.00	0.00	4.
1.01	3.00	6	.04	.00	.04	2.	1.02	4.00	56	0.00	0.00	0.00	3.
1.01	3.30	7	.04	.00	.04	2.	1.02	4.30	57	0.00	0.00	0.00	3.
1.01	4.00	8	.04	.00	.04	2.	1.02	5.00	58	0.00	0.00	0.00	3.
1.01	4.30	9	.04	.00	.04	2.	1.02	5.30	59	0.00	0.00	0.00	2.
1.01	5.00	10	.04	.00	.04	1.	1.02	6.00	60	0.00	0.00	0.00	2.
1.01	5.30	11	.04	.00	.04	1.	1.02	6.30	61	0.00	0.00	0.00	2.
1.01	6.00	12	.04	.00	.04	1.	1.02	7.00	62	0.00	0.00	0.00	2.
1.01	6.30	13	.08	.01	.08	2.	1.02	7.30	63	0.00	0.00	0.00	2.
1.01	7.00	14	.08	.01	.08	2.	1.02	8.00	64	0.00	0.00	0.00	2.
1.01	7.30	15	.08	.01	.08	2.	1.02	8.30	65	0.00	0.00	0.00	1.
1.01	8.00	16	.08	.01	.08	2.	1.02	9.00	66	0.00	0.00	0.00	1.
1.01	8.30	17	.08	.01	.08	2.	1.02	9.30	67	0.00	0.00	0.00	1.
1.01	9.00	18	.08	.01	.08	2.	1.02	10.00	68	0.00	0.00	0.00	1.
1.01	9.30	19	.13	.01	.12	3.	1.02	10.30	69	0.00	0.00	0.00	1.
1.01	10.00	20	.15	.02	.12	3.	1.02	11.00	70	0.00	0.00	0.00	1.
1.01	10.30	21	.13	.02	.11	4.	1.02	11.30	71	0.00	0.00	0.00	1.
1.01	11.00	22	.19	.04	.15	7.	1.02	12.00	72	0.00	0.00	0.00	1.
1.01	11.30	23	.37	.10	.27	17.	1.02	12.30	73	0.00	0.00	0.00	1.
1.01	12.00	24	1.45	.64	.81	102.	1.02	13.00	74	0.00	0.00	0.00	1.
1.01	12.30	25	1.85	1.17	.68	206.	1.02	13.30	75	0.00	0.00	0.00	1.
1.01	13.00	26	.37	.26	.11	95.	1.02	14.00	76	0.00	0.00	0.00	1.
1.01	13.30	27	.19	.14	.05	43.	1.02	14.30	77	0.00	0.00	0.00	0.
1.01	14.00	28	.13	.10	.03	25.	1.02	15.00	78	0.00	0.00	0.00	0.
1.01	14.30	29	.13	.10	.03	21.	1.02	15.30	79	0.00	0.00	0.00	0.
1.01	15.00	30	.13	.10	.03	20.	1.02	16.00	80	0.00	0.00	0.00	0.
1.01	15.30	31	.08	.06	.02	19.	1.02	16.30	81	0.00	0.00	0.00	0.
1.01	16.00	32	.08	.06	.02	17.	1.02	17.00	82	0.00	0.00	0.00	0.
1.01	16.30	33	.08	.06	.02	15.	1.02	17.30	83	0.00	0.00	0.00	0.
1.01	17.00	34	.08	.06	.02	14.	1.02	18.00	84	0.00	0.00	0.00	0.
1.01	17.30	35	.08	.06	.02	13.	1.02	18.30	85	0.00	0.00	0.00	0.
1.01	18.00	36	.08	.06	.02	13.	1.02	19.00	86	0.00	0.00	0.00	0.
1.01	18.30	37	.04	.03	.01	12.	1.02	19.30	87	0.00	0.00	0.00	0.
1.01	19.00	38	.04	.03	.01	11.	1.02	20.00	88	0.00	0.00	0.00	0.
1.01	19.30	39	.04	.03	.01	10.	1.02	20.30	89	0.00	0.00	0.00	0.
1.01	20.00	40	.04	.03	.01	9.	1.02	21.00	90	0.00	0.00	0.00	0.
1.01	20.30	41	.04	.03	.01	8.	1.02	21.30	91	0.00	0.00	0.00	0.
1.01	21.00	42	.04	.03	.01	8.	1.02	22.00	92	0.00	0.00	0.00	0.
1.01	21.30	43	.04	.03	.01	7.	1.02	22.30	93	0.00	0.00	0.00	0.
1.01	22.00	44	.04	.03	.01	7.	1.02	23.00	94	0.00	0.00	0.00	0.
1.01	22.30	45	.04	.03	.01	7.	1.02	23.30	95	0.00	0.00	0.00	0.
1.01	23.00	46	.04	.03	.01	7.	1.03	0.00	96	0.00	0.00	0.00	0.
1.01	23.30	47	.04	.03	.01	7.	1.03	.30	97	0.00	0.00	0.00	0.
1.02	0.00	48	.04	.03	.01	7.	1.03	1.00	98	0.00	0.00	0.00	0.
1.02	.30	49	0.00	0.00	0.00	6.	1.03	1.30	99	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00	6.	1.03	2.00	100	0.00	0.00	0.00	0.
									SUM	7.21	3.57	3.64	837.
										(183.)(	91.)(	93.)(	23.70)

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**********          **********          **********          **********          **********

                                   HYDROGRAPH ROUTING

              100-YR FLOOD ROUTING THROUGH OUTLET PIPE

                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         U POND       1       0       0       0       0       1       0       0
                                                ROUTING DATA
                  QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP           LSTR
                    0.0   0.000    0.00       1       1       0       0              0

                          NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                              1       0       0   0.000   0.000   0.000   -986.      -1

      STAGE     986.30     986.50     986.60     987.00     987.70     988.00     989.00     991.50     995.00    1000.00

       FLOW       0.00       1.40       2.00       3.10       4.50       4.90       6.20       6.60       7.20       7.90

SURFACE AREA=      10.        17.        28.        38.        46.        52.        56.        60.

    CAPACITY=       0.        23.        67.       133.       217.       315.       423.       539.

   ELEVATION=     986.       988.       990.       992.       994.       996.       998.      1000.

                     CREL   SPWID   COQW    EXPW   ELEVL    COOL   CAREA    EXPL
                    986.3     0.0    0.0     0.0     0.0     0.0     0.0     0.0

                                             DAM DATA
                                     TOPEL    COQD    EXPD  DAMWID
                                     998.8     0.0     0.0      0.
```

STATION U POND, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.30	1	.50	2.	1.	1.	986.4
1.01	1.00	2	1.00	2.	1.	1.	986.4
1.01	1.30	3	1.50	2.	1.	1.	986.4
1.01	2.00	4	2.00	2.	1.	1.	986.4
1.01	2.30	5	2.50	2.	1.	1.	986.4
1.01	3.00	6	3.00	2.	1.	1.	986.4
1.01	3.30	7	3.50	2.	1.	1.	986.4
1.01	4.00	8	4.00	2.	1.	1.	986.4
1.01	4.30	9	4.50	2.	1.	1.	986.4
1.01	5.00	10	5.00	1.	1.	1.	986.4
1.01	5.30	11	5.50	1.	1.	1.	986.4
1.01	6.00	12	6.00	1.	1.	1.	986.4
1.01	6.30	13	6.50	2.	1.	1.	986.4
1.01	7.00	14	7.00	2.	1.	2.	986.4
1.01	7.30	15	7.50	2.	1.	2.	986.5
1.01	8.00	16	8.00	2.	1.	2.	986.5
1.01	8.30	17	8.50	2.	1.	2.	986.5
1.01	9.00	18	9.00	2.	1.	2.	986.5
1.01	9.30	19	9.50	3.	1.	2.	986.5
1.01	10.00	20	10.00	3.	1.	2.	986.5
1.01	10.30	21	10.50	4.	1.	2.	986.5
1.01	11.00	22	11.00	7.	1.	2.	986.5
1.01	11.30	23	11.50	17.	2.	3.	986.5
1.01	12.00	24	12.00	102.	2.	5.	986.8
1.01	12.30	25	12.50	206.	4.	11.	987.2
1.01	13.00	26	13.00	95.	4.	17.	987.7
1.01	13.30	27	13.50	43.	5.	20.	987.8
1.01	14.00	28	14.00	25.	5.	21.	987.9
1.01	14.30	29	14.50	21.	5.	22.	987.9
1.01	15.00	30	15.00	20.	5.	22.	988.0
1.01	15.30	31	15.50	19.	5.	23.	988.0
1.01	16.00	32	16.00	17.	5.	24.	988.1
1.01	16.30	33	16.50	15.	5.	24.	988.1
1.01	17.00	34	17.00	14.	5.	24.	988.1
1.01	17.30	35	17.50	13.	5.	25.	988.1
1.01	18.00	36	18.00	13.	5.	25.	988.1
1.01	18.30	37	18.50	12.	5.	25.	988.2
1.01	19.00	38	19.00	11.	5.	26.	988.2
1.01	19.30	39	19.50	10.	5.	26.	988.2
1.01	20.00	40	20.00	9.	5.	26.	988.2
1.01	20.30	41	20.50	8.	5.	26.	988.2
1.01	21.00	42	21.00	8.	5.	26.	988.2
1.01	21.30	43	21.50	7.	5.	26.	988.2
1.01	22.00	44	22.00	7.	5.	26.	988.2
1.01	22.30	45	22.50	7.	5.	27.	988.2
1.01	23.00	46	23.00	7.	5.	27.	988.2
1.01	23.30	47	23.50	7.	5.	27.	988.2
1.02	0.00	48	24.00	7.	5.	27.	988.2
1.02	.30	49	24.50	6.	5.	27.	988.2
1.02	1.00	50	25.00	6.	5.	27.	988.2
1.02	1.30	51	25.50	5.	5.	27.	988.2
1.02	2.00	52	26.00	5.	5.	27.	988.2
1.02	2.30	53	26.50	4.	5.	27.	988.2
1.02	3.00	54	27.00	4.	5.	27.	988.2
1.02	3.30	55	27.50	4.	5.	27.	988.2
1.02	4.00	56	28.00	3.	5.	27.	988.2
1.02	4.30	57	28.50	3.	5.	27.	988.2
1.02	5.00	58	29.00	3.	5.	26.	988.2
1.02	5.30	59	29.50	2.	5.	26.	988.2
1.02	6.00	60	30.00	2.	5.	26.	988.2
1.02	6.30	61	30.50	2.	5.	26.	988.2
1.02	7.00	62	31.00	2.	5.	26.	988.2
1.02	7.30	63	31.50	2.	5.	26.	988.2
1.02	8.00	64	32.00	2.	5.	26.	988.2
1.02	8.30	65	32.50	1.	5.	26.	988.2
1.02	9.00	66	33.00	1.	5.	25.	988.2
1.02	9.30	67	33.50	1.	5.	25.	988.1
1.02	10.00	68	34.00	1.	5.	25.	988.1
1.02	10.30	69	34.50	1.	5.	25.	988.1
1.02	11.00	70	35.00	1.	5.	25.	988.1
1.02	11.30	71	35.50	1.	5.	25.	988.1
1.02	12.00	72	36.00	1.	5.	24.	988.1
1.02	12.30	73	36.50	1.	5.	24.	988.1
1.02	13.00	74	37.00	1.	5.	24.	988.1
1.02	13.30	75	37.50	1.	5.	24.	988.1
1.02	14.00	76	38.00	1.	5.	24.	988.1
1.02	14.30	77	38.50	0.	5.	24.	988.0
1.02	15.00	78	39.00	0.	5.	23.	988.0
1.02	15.30	79	39.50	0.	5.	23.	988.0
1.02	16.00	80	40.00	0.	5.	23.	988.0
1.02	16.30	81	40.50	0.	5.	23.	988.0
1.02	17.00	82	41.00	0.	5.	23.	988.0
1.02	17.30	83	41.50	0.	5.	22.	988.0
1.02	18.00	84	42.00	0.	5.	22.	988.0
1.02	18.30	85	42.50	0.	5.	22.	988.0
1.02	19.00	86	43.00	0.	5.	22.	988.0
1.02	19.30	87	43.50	0.	5.	22.	987.9
1.02	20.00	88	44.00	0.	5.	21.	987.9
1.02	20.30	89	44.50	0.	5.	21.	987.9
1.02	21.00	90	45.00	0.	5.	21.	987.9
1.02	21.30	91	45.50	0.	5.	21.	987.9
1.02	22.00	92	46.00	0.	5.	21.	987.9
1.02	22.30	93	46.50	0.	5.	21.	987.9
1.02	23.00	94	47.00	0.	5.	20.	987.9
1.02	23.30	95	47.50	0.	5.	20.	987.8
1.03	0.00	96	48.00	0.	5.	20.	987.8
1.03	.30	97	48.50	0.	5.	20.	987.8
1.03	1.00	98	49.00	0.	5.	20.	987.8
1.03	1.30	99	49.50	0.	5.	19.	987.8
1.03	2.00	100	50.00	0.	5.	19.	987.8

PEAK OUTFLOW IS 5. AT TIME 25.50 HOURS

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM LOWER WATERSHED TO DAM NO. 30717, SULLIVAN PRECIP, 30 MIN. INCR,

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
RUNOFF	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	1.01	0.00	1.01	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
-48	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-57.00	0.00	.05

CURVE NO = -57.00 WETNESS = -1.00 EFFECT CN = 57.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 2.40

RECESSION DATA
STRTQ= -10.00 QRCSN= -.10 RTIOR= 2.50

UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 2.40 VOL= 1.00

17.	52.	110.	163.	184.	179.	156.	124.	85.	62.
47.	35.	25.	19.	14.	10.	7.	5.	4.	3.
2.	2.	1.	1.	1.	0.				

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.04	.00	.04	9.	1.02	1.30	51	0.00	0.00	0.00	34.
1.01	1.00	2	.04	.00	.04	9.	1.02	2.00	52	0.00	0.00	0.00	30.
1.01	1.30	3	.04	.00	.04	8.	1.02	2.30	53	0.00	0.00	0.00	27.
1.01	2.00	4	.04	.00	.04	8.	1.02	3.00	54	0.00	0.00	0.00	25.
1.01	2.30	5	.04	.00	.04	8.	1.02	3.30	55	0.00	0.00	0.00	23.
1.01	3.00	6	.04	.00	.04	7.	1.02	4.00	56	0.00	0.00	0.00	21.
1.01	3.30	7	.04	.00	.04	7.	1.02	4.30	57	0.00	0.00	0.00	19.
1.01	4.00	8	.04	.00	.04	7.	1.02	5.00	58	0.00	0.00	0.00	17.
1.01	4.30	9	.04	.00	.04	7.	1.02	5.30	59	0.00	0.00	0.00	16.
1.01	5.00	10	.04	.00	.04	6.	1.02	6.00	60	0.00	0.00	0.00	14.
1.01	5.30	11	.04	.00	.04	6.	1.02	6.30	61	0.00	0.00	0.00	13.

1.01	6.00	12	.04	.00	.04	6.	1.02	7.00	62	0.00	0.00	0.00	12.
1.01	6.30	13	.08	.00	.08	6.	1.02	7.30	63	0.00	0.00	0.00	11.
1.01	7.00	14	.08	.00	.08	6.	1.02	8.00	64	0.00	0.00	0.00	10.
1.01	7.30	15	.08	.00	.08	6.	1.02	8.30	65	0.00	0.00	0.00	9.
1.01	8.00	16	.08	.00	.08	6.	1.02	9.00	66	0.00	0.00	0.00	8.
1.01	8.30	17	.08	.00	.08	6.	1.02	9.30	67	0.00	0.00	0.00	8.
1.01	9.00	18	.08	.00	.08	6.	1.02	10.00	68	0.00	0.00	0.00	7.
1.01	9.30	19	.13	.01	.13	6.	1.02	10.30	69	0.00	0.00	0.00	6.
1.01	10.00	20	.13	.01	.13	7.	1.02	11.00	70	0.00	0.00	0.00	6.
1.01	10.30	21	.13	.01	.13	7.	1.02	11.30	71	0.00	0.00	0.00	5.
1.01	11.00	22	.19	.01	.18	7.	1.02	12.00	72	0.00	0.00	0.00	5.
1.01	11.30	23	.37	.04	.32	8.	1.02	12.30	73	0.00	0.00	0.00	4.
1.01	12.00	24	1.45	.41	1.04	17.	1.02	13.00	74	0.00	0.00	0.00	4.
1.01	12.30	25	1.85	.91	.94	49.	1.02	13.30	75	0.00	0.00	0.00	4.
1.01	13.00	26	.37	.22	.15	110.	1.02	14.00	76	0.00	0.00	0.00	3.
1.01	13.30	27	.19	.11	.07	194.	1.02	14.30	77	0.00	0.00	0.00	3.
1.01	14.00	28	.13	.08	.05	267.	1.02	15.00	78	0.00	0.00	0.00	3.
1.01	14.30	29	.13	.08	.05	305.	1.02	15.30	79	0.00	0.00	0.00	3.
1.01	15.00	30	.13	.08	.05	309.	1.02	16.00	80	0.00	0.00	0.00	2.
1.01	15.30	31	.08	.05	.03	286.	1.02	16.30	81	0.00	0.00	0.00	2.
1.01	16.00	32	.08	.05	.03	248.	1.02	17.00	82	0.00	0.00	0.00	2.
1.01	16.30	33	.08	.05	.03	204.	1.02	17.30	83	0.00	0.00	0.00	2.
1.01	17.00	34	.08	.06	.03	173.	1.02	18.00	84	0.00	0.00	0.00	2.
1.01	17.30	35	.08	.06	.03	149.	1.02	18.30	85	0.00	0.00	0.00	1.
1.01	18.00	36	.08	.06	.03	129.	1.02	19.00	86	0.00	0.00	0.00	1.
1.01	18.30	37	.04	.03	.01	114.	1.02	19.30	87	0.00	0.00	0.00	1.
1.01	19.00	38	.04	.03	.01	101.	1.02	20.00	88	0.00	0.00	0.00	1.
1.01	19.30	39	.04	.03	.01	90.	1.02	20.30	89	0.00	0.00	0.00	1.
1.01	20.00	40	.04	.03	.01	80.	1.02	21.00	90	0.00	0.00	0.00	1.
1.01	20.30	41	.04	.03	.01	70.	1.02	21.30	91	0.00	0.00	0.00	1.
1.01	21.00	42	.04	.03	.01	62.	1.02	22.00	92	0.00	0.00	0.00	1.
1.01	21.30	43	.04	.03	.01	56.	1.02	22.30	93	0.00	0.00	0.00	1.
1.01	22.00	44	.04	.03	.01	51.	1.02	23.00	94	0.00	0.00	0.00	1.
1.01	22.30	45	.04	.03	.01	47.	1.02	23.30	95	0.00	0.00	0.00	1.
1.01	23.00	46	.04	.03	.01	45.	1.03	0.00	96	0.00	0.00	0.00	1.
1.01	23.30	47	.04	.03	.01	43.	1.03	.30	97	0.00	0.00	0.00	0.
1.02	0.00	48	.04	.03	.01	41.	1.03	1.00	98	0.00	0.00	0.00	0.
1.02	.30	49	0.00	0.00	0.00	40.	1.03	1.30	99	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00	37.	1.03	2.00	100	0.00	0.00	0.00	0.
									SUM	7.21	2.69	4.52	3848.
										(183.)(	68.)(	115.)(	108.96)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	309.	207.	76.	38.	3842.
CMS	9.	6.	2.	1.	109.
INCHES		1.90	2.79	2.94	2.94
MM		48.23	70.75	74.61	74.61
AC-FT		103.	151.	159.	159.
THOUS CU M		127.	186.	196.	196.

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**********          **********          **********          **********          **********

                                   COMBINE HYDROGRAPHS

              COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        UP+LOW      2       0       0       0       0       1       0       0

                         SUM OF 2 HYDROGRAPHS AT  UP+LOW  PLAN 1  RTIO 1
     10.        9.        9.        9.        8.        8.        8.        8.        8.        7.
      7.        7.        7.        7.        7.        7.        7.        7.        8.        8.
      8.        9.       10.       20.       53.      115.      199.      272.      310.      314.
    291.      253.      209.      178.      154.      135.      119.      106.       95.       85.
     76.       68.       61.       56.       53.       50.       48.       47.       45.       43.
     39.       35.       32.       30.       28.       26.       24.       22.       21.       19.
     18.       17.       16.       15.       14.       13.       13.       12.       11.       11.
     10.       10.        9.        9.        9.        8.        8.        8.        7.        7.
      7.        7.        7.        6.        6.        6.        6.        6.        6.        6.
      6.        6.        5.        5.        5.        5.        5.        5.        5.        5.

                            PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                 CFS        314.      212.       81.       42.          4244.
                 CMS          9.        6.        2.        1.           120.
              INCHES                  1.68      2.56      2.81           2.81
                  MM                 42.70     65.12     71.26          71.26
               AC-FT                  105.      160.      175.           175.
          THOUS CU M                  130.      198.      216.           216.


**********          **********          **********          **********          **********

                                   HYDROGRAPH ROUTING

              100-YR FLOOD ROUTING THROUGH LOWER POND

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        L POND      1       0       0       0       0       1       0       0
                                                ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       0       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000   -945.      -1

 STAGE        944.00     944.80     945.50     946.50     947.90     949.30     950.70     952.10     954.80     957.50

  FLOW          4.50       4.60      33.00     141.00     418.00     798.00    1269.00    1834.00    3237.00    5008.00

SURFACE AREA=      28.        40.        53.        62.        70.        80.        86.

   CAPACITY=        0.       101.       241.       355.       487.       637.       762.

  ELEVATION=      944.       947.       950.       952.       954.       956.       957.

                        CREL   SPWID   COQW    EXPW   ELEVL    COOL   CAREA    EXPL
                       944.8     0.0    0.0     0.0     0.0     0.0     0.0     0.0
```

DAM DATA

TOPEL	COQD	EXPD	DAMWID
957.5	0.0	0.0	0.

STATION L POND, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.30	1	.50	10.	5.	24.	944.8
1.01	1.00	2	1.00	9.	5.	24.	944.8
1.01	1.30	3	1.50	9.	5.	24.	944.8
1.01	2.00	4	2.00	9.	6.	24.	944.8
1.01	2.30	5	2.50	8.	6.	24.	944.8
1.01	3.00	6	3.00	8.	6.	25.	944.8
1.01	3.30	7	3.50	8.	6.	25.	944.8
1.01	4.00	8	4.00	8.	6.	25.	944.8
1.01	4.30	9	4.50	8.	6.	25.	944.8
1.01	5.00	10	5.00	7.	6.	25.	944.8
1.01	5.30	11	5.50	7.	6.	25.	944.8
1.01	6.00	12	6.00	7.	6.	25.	944.8
1.01	6.30	13	6.50	7.	6.	25.	944.8
1.01	7.00	14	7.00	7.	6.	25.	944.8
1.01	7.30	15	7.50	7.	6.	25.	944.8
1.01	8.00	16	8.00	7.	6.	25.	944.8
1.01	8.30	17	8.50	7.	6.	25.	944.8
1.01	9.00	18	9.00	7.	6.	25.	944.8
1.01	9.30	19	9.50	8.	7.	25.	944.8
1.01	10.00	20	10.00	8.	7.	25.	944.8
1.01	10.30	21	10.50	8.	7.	25.	944.9
1.01	11.00	22	11.00	9.	7.	25.	944.9
1.01	11.30	23	11.50	10.	7.	25.	944.9
1.01	12.00	24	12.00	20.	7.	26.	944.9
1.01	12.30	25	12.50	53.	9.	27.	944.9
1.01	13.00	26	13.00	115.	13.	30.	945.0
1.01	13.30	27	13.50	199.	20.	36.	945.2
1.01	14.00	28	14.00	272.	31.	44.	945.4
1.01	14.30	29	14.50	310.	59.	54.	945.7
1.01	15.00	30	15.00	314.	89.	64.	946.0
1.01	15.30	31	15.50	291.	114.	73.	946.2
1.01	16.00	32	16.00	255.	132.	79.	946.4
1.01	16.30	33	16.50	209.	144.	83.	946.5
1.01	17.00	34	17.00	176.	154.	84.	946.6
1.01	17.30	35	17.50	154.	155.	85.	946.6
1.01	18.00	36	18.00	135.	154.	84.	946.6
1.01	18.30	37	18.50	119.	149.	83.	946.5
1.01	19.00	38	19.00	106.	142.	82.	946.5
1.01	19.30	39	19.50	95.	137.	81.	946.5
1.01	20.00	40	20.00	85.	132.	79.	946.4
1.01	20.30	41	20.50	76.	126.	77.	946.4
1.01	21.00	42	21.00	68.	120.	75.	946.3
1.01	21.30	43	21.50	61.	114.	73.	946.2
1.01	22.00	44	22.00	56.	107.	70.	946.2
1.01	22.30	45	22.50	53.	101.	68.	946.1
1.01	23.00	46	23.00	50.	95.	66.	946.1
1.01	23.30	47	23.50	48.	90.	65.	946.0
1.02	0.00	48	24.00	47.	85.	63.	946.0
1.02	.30	49	24.50	45.	80.	61.	945.9
1.02	1.00	50	25.00	43.	76.	60.	945.9
1.02	1.30	51	25.50	39.	72.	59.	945.9
1.02	2.00	52	26.00	35.	68.	57.	945.8
1.02	2.30	53	26.50	32.	64.	56.	945.8
1.02	3.00	54	27.00	30.	60.	55.	945.7
1.02	3.30	55	27.50	28.	56.	54.	945.7
1.02	4.00	56	28.00	26.	53.	52.	945.7
1.02	4.30	57	28.50	24.	49.	51.	945.6
1.02	5.00	58	29.00	22.	46.	50.	945.6
1.02	5.30	59	29.50	21.	43.	49.	945.6
1.02	6.00	60	30.00	19.	40.	48.	945.6
1.02	6.30	61	30.50	18.	38.	48.	945.5
1.02	7.00	62	31.00	17.	35.	47.	945.5
1.02	7.30	63	31.50	16.	33.	46.	945.5
1.02	8.00	64	32.00	15.	32.	45.	945.5
1.02	8.30	65	32.50	14.	31.	45.	945.5
1.02	9.00	66	33.00	13.	30.	44.	945.4
1.02	9.30	67	33.50	13.	30.	43.	945.4
1.02	10.00	68	34.00	12.	29.	43.	945.4
1.02	10.30	69	34.50	11.	28.	42.	945.4
1.02	11.00	70	35.00	11.	27.	41.	945.4
1.02	11.30	71	35.50	10.	26.	41.	945.3
1.02	12.00	72	36.00	10.	25.	40.	945.3
1.02	12.30	73	36.50	9.	25.	39.	945.3
1.02	13.00	74	37.00	9.	24.	39.	945.3
1.02	13.30	75	37.50	9.	23.	38.	945.3
1.02	14.00	76	38.00	8.	22.	38.	945.2
1.02	14.30	77	38.50	8.	22.	37.	945.2
1.02	15.00	78	39.00	8.	21.	36.	945.2
1.02	15.30	79	39.50	7.	20.	36.	945.2
1.02	16.00	80	40.00	7.	20.	35.	945.2
1.02	16.30	81	40.50	7.	19.	35.	945.2
1.02	17.00	82	41.00	7.	18.	34.	945.1
1.02	17.30	83	41.50	7.	18.	34.	945.1
1.02	18.00	84	42.00	6.	17.	33.	945.1
1.02	18.30	85	42.50	6.	17.	33.	945.1
1.02	19.00	86	43.00	6.	16.	33.	945.1
1.02	19.30	87	43.50	6.	16.	32.	945.1
1.02	20.00	88	44.00	6.	15.	32.	945.1
1.02	20.30	89	44.50	6.	15.	31.	945.0
1.02	21.00	90	45.00	6.	14.	31.	945.0
1.02	21.30	91	45.50	6.	14.	31.	945.0
1.02	22.00	92	46.00	6.	13.	30.	945.0

1.02	22.30	93	46.50	5.	13.	30.	945.0
1.02	23.00	94	47.00	5.	13.	30.	945.0
1.02	23.30	95	47.50	5.	12.	29.	945.0
1.03	0.00	96	48.00	5.	12.	29.	945.0
1.03	.30	97	48.50	5.	12.	29.	945.0
1.03	1.00	98	49.00	5.	11.	29.	945.0
1.03	1.30	99	49.50	5.	11.	28.	945.0
1.03	2.00	100	50.00	5.	11.	28.	944.9

PEAK OUTFLOW IS 156. AT TIME 17.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	156.	138.	74.	41.	4146.
CMS	4.	4.	2.	1.	117.
INCHES		1.10	2.36	2.74	2.74
MM		27.83	59.95	69.61	69.61
AC-FT		68.	148.	171.	171.
THOUS CU M		84.	182.	211.	211.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
HYDROGRAPH AT	INFLOW	.16 (.41)	1	206. (5.83)(
ROUTED TO	U POND	.16 (.41)	1	5. (.15)(
HYDROGRAPH AT	RUNOFF	1.01 (2.63)	1	309. (8.74)(
2 COMBINED	UP+LOW	1.17 (3.04)	1	314. (8.88)(
ROUTED TO	L POND	1.17 (3.04)	1	156. (4.42)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ...100-yr...............

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	986.40	986.30	998.80
STORAGE	1.	0.	468.
OUTFLOW	1.	0.	8.

MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
986.24	0.00	27.	5.	0.00	25.50	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ...100-yr.........

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	944.80	944.80	957.50
STORAGE	24.	24.	762.
OUTFLOW	5.	5.	5008.

MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
946.58	0.00	85.	156.	0.00	17.50	0.00

```
A1         INDIAN CREEK MINE DAM MO. NO. 31036 AND 30717
A2         HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3         10 YEAR FLOOD
B      100                30                                                2
B1       5
J        1         1         1
J1       1
K        0  INFLOW                                            1
K1  RUNOFF FROM UPPER WATERSHED TO POND, #31036, SULLIVAN PRECIP. 30 MIN. INCR.
M        0         2     .1586
O       48
O1     .03       .03       .03       .03       .03       .03       .03       .03       .03       .03
O1     .03       .03       .06       .06       .06       .06       .06       .06       .09       .09
O1     .09      .186      .294      .959     1.267      .294      .186       .09       .09       .09
O1     .06       .06       .06       .06       .06       .06       .03       .03       .03       .03
O1     .03       .03       .03       .03       .03       .03       .03       .03
T                                                              -1       -64                  .1
W2                 .17
X      -10       -.1       2.5
K        1  U POND                                            1
K1  10-YR FLOOD ROUTING THROUGH OUTLET PIPE
Y                                    1         1
Y1       1                                               -986.4        -1
Y4   986.3     986.5     986.6     987.0     987.7     988.0     989.0     991.5     995.0    1000.0
Y5       0       1.4         2       3.1       4.5       4.9       6.2       6.6       7.2       7.9
$A      10        17        28        38        46        52        56        60
$E   986.3       988       990       992       994       996       998      1000
$$   986.3
$D   998.8
```

```
K       0  RUNOFF                                                         1
K1   INFLOW FROM LOWER WATERSHED TO DAM NO. 30717, SULLIVAN PRECIP. 30 MIN. INCR.
M       0         2   1.014
O     -48
T                                                                        -1      -57            .05
W2              2.4
X     -10       -.1       2.5
K       2  UP+LOW                                                         1
K1   COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED
K       1  L POND                                                         1
K1   10-YR FLOOD ROUTING THROUGH LOWER POND
Y                                          1
Y1      1                                                          -944.8       -1
Y4  944.0     944.8     945.5     946.5     947.9     949.3     950.7     952.1     954.8     957.5
Y5    4.5       4.6        33       141       418       798      1269      1834      3237      5008
$A     28        40        53        62        70        80        86
$E    944       947       950       952       954       956     957.5
$$  944.8
$D  957.5
K      99
A
A
A
A
A
```

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE* 79/11/02.
     TIME* 09.20.59.


                    INDIAN CREEK MINE DAM NO. NO. 31036 AND 30717
                    HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
                    10 YEAR FLOOD

                                JOB SPECIFICATION
     NO       NHR      NMIN     IDAY      IHR      IMIN    METRC     IPLT     IPRT    NSTAN
    100         0        30        0        0         0        0        0        2        0
                              JOPER      NWT     LROPT    TRACE
                                  5        0         0        0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                             NPLAN= 1 NRTIO= 1 LRTIO= 1
      RTIOS=    1.00


**********        **********        **********        **********        **********

                              SUB-AREA RUNOFF COMPUTATION

    RUNOFF FROM UPPER WATERSHED TO POND, #31036, SULLIVAN PRECIP, 30 MIN. INCR.

              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
             INFLOW       0       0       0       0       0       1       0       0

                                  HYDROGRAPH DATA
    IHYDG    IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO   ISNOW   ISAME   LOCAL
        0       2      .16     0.00      .16     0.00    0.000       0       0       0

                                    PRECIP DATA
                              NP    STORM     DAJ     DAK
                              48     0.00    0.00    0.00
                                   PRECIP PATTERN
   .03        .03        .03        .03        .03        .03        .03        .03        .03        .03
   .03        .03        .06        .06        .06        .06        .06        .06        .09        .09
   .09        .19        .29        .96       1.27        .29        .19        .09        .09        .09
   .06        .06        .06        .06        .06        .06        .03        .03        .03        .03
   .03        .03        .03        .03        .03        .03        .03        .03

                                     LOSS DATA
  LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
      0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -64.00    0.00     .10

     CURVE NO =  -64.00  WETNESS =   -1.00  EFFECT CN =   64.00

                                UNIT HYDROGRAPH DATA
                              TC=  0.00     LAG=   .17
```

RECESSION DATA
STRTQ= -10.00 QRCSN= -.10 RTIOR= 2.50

TIME INCREMENT TOO LARGE--(NHG IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00
152. 43. 8. 2. 0.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.03	.00	.03	2.	1.02	1.30	51	0.00	0.00	0.00	3.
1.01	1.00	2	.03	.00	.03	2.	1.02	2.00	52	0.00	0.00	0.00	3.
1.01	1.30	3	.03	.00	.03	2.	1.02	2.30	53	0.00	0.00	0.00	3.
1.01	2.00	4	.03	.00	.03	2.	1.02	3.00	54	0.00	0.00	0.00	2.
1.01	2.30	5	.03	.00	.03	2.	1.02	3.30	55	0.00	0.00	0.00	2.
1.01	3.00	6	.03	.00	.03	2.	1.02	4.00	56	0.00	0.00	0.00	2.
1.01	3.30	7	.03	.00	.03	1.	1.02	4.30	57	0.00	0.00	0.00	2.
1.01	4.00	8	.03	.00	.03	1.	1.02	5.00	58	0.00	0.00	0.00	2.
1.01	4.30	9	.03	.00	.03	1.	1.02	5.30	59	0.00	0.00	0.00	2.
1.01	5.00	10	.03	.00	.03	1.	1.02	6.00	60	0.00	0.00	0.00	1.
1.01	5.30	11	.03	.00	.03	1.	1.02	6.30	61	0.00	0.00	0.00	1.
1.01	6.00	12	.03	.00	.03	1.	1.02	7.00	62	0.00	0.00	0.00	1.
1.01	6.30	13	.06	.01	.05	2.	1.02	7.30	63	0.00	0.00	0.00	1.
1.01	7.00	14	.06	.01	.05	2.	1.02	8.00	64	0.00	0.00	0.00	1.
1.01	7.30	15	.06	.01	.05	2.	1.02	8.30	65	0.00	0.00	0.00	1.
1.01	8.00	16	.06	.01	.05	2.	1.02	9.00	66	0.00	0.00	0.00	1.
1.01	8.30	17	.06	.01	.05	2.	1.02	9.30	67	0.00	0.00	0.00	1.
1.01	9.00	18	.06	.01	.05	2.	1.02	10.00	68	0.00	0.00	0.00	1.
1.01	9.30	19	.09	.01	.08	2.	1.02	10.30	69	0.00	0.00	0.00	1.
1.01	10.00	20	.09	.01	.08	2.	1.02	11.00	70	0.00	0.00	0.00	1.
1.01	10.30	21	.09	.01	.08	2.	1.02	11.30	71	0.00	0.00	0.00	1.
1.01	11.00	22	.19	.02	.17	4.	1.02	12.00	72	0.00	0.00	0.00	0.
1.01	11.30	23	.29	.05	.25	6.	1.02	12.30	73	0.00	0.00	0.00	0.
1.01	12.00	24	.96	.30	.66	48.	1.02	13.00	74	0.00	0.00	0.00	0.
1.01	12.30	25	1.27	.63	.64	109.	1.02	13.30	75	0.00	0.00	0.00	0.
1.01	13.00	26	.29	.17	.12	56.	1.02	14.00	76	0.00	0.00	0.00	0.
1.01	13.30	27	.19	.11	.07	31.	1.02	14.30	77	0.00	0.00	0.00	0.
1.01	14.00	28	.09	.06	.03	16.	1.02	15.00	78	0.00	0.00	0.00	0.
1.01	14.30	29	.09	.06	.03	12.	1.02	15.30	79	0.00	0.00	0.00	0.
1.01	15.00	30	.09	.06	.03	12.	1.02	16.00	80	0.00	0.00	0.00	0.
1.01	15.30	31	.06	.04	.02	10.	1.02	16.30	81	0.00	0.00	0.00	0.
1.01	16.00	32	.06	.04	.02	9.	1.02	17.00	82	0.00	0.00	0.00	0.
1.01	16.30	33	.06	.04	.02	9.	1.02	17.30	83	0.00	0.00	0.00	0.
1.01	17.00	34	.06	.04	.02	8.	1.02	18.00	84	0.00	0.00	0.00	0.
1.01	17.30	35	.06	.04	.02	8.	1.02	18.30	85	0.00	0.00	0.00	0.
1.01	18.00	36	.06	.04	.02	8.	1.02	19.00	86	0.00	0.00	0.00	0.
1.01	18.30	37	.03	.02	.01	8.	1.02	19.30	87	0.00	0.00	0.00	0.
1.01	19.00	38	.03	.02	.01	7.	1.02	20.00	88	0.00	0.00	0.00	0.
1.01	19.30	39	.03	.02	.01	6.	1.02	20.30	89	0.00	0.00	0.00	0.
1.01	20.00	40	.03	.02	.01	6.	1.02	21.00	90	0.00	0.00	0.00	0.
1.01	20.30	41	.03	.02	.01	5.	1.02	21.30	91	0.00	0.00	0.00	0.
1.01	21.00	42	.03	.02	.01	5.	1.02	22.00	92	0.00	0.00	0.00	0.
1.01	21.30	43	.03	.02	.01	4.	1.02	22.30	93	0.00	0.00	0.00	0.
1.01	22.00	44	.03	.02	.01	4.	1.02	23.00	94	0.00	0.00	0.00	0.
1.01	22.30	45	.03	.02	.01	4.	1.02	23.30	95	0.00	0.00	0.00	0.
1.01	23.00	46	.03	.02	.01	4.	1.03	0.00	96	0.00	0.00	0.00	0.
1.01	23.30	47	.03	.02	.01	4.	1.03	.30	97	0.00	0.00	0.00	0.
1.02	0.00	48	.03	.02	.01	4.	1.03	1.00	98	0.00	0.00	0.00	0.
1.02	.30	49	0.00	0.00	0.00	4.	1.03	1.30	99	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00	4.	1.03	2.00	100	0.00	0.00	0.00	0.
									SUM	5.17	2.04	3.13	486.
										(131.)(	52.)(	79.)(	13.76)

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**********          **********          **********          **********          **********

                                   HYDROGRAPH ROUTING

                10-YR FLOOD ROUTING THROUGH OUTLET PIPE

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        U POND       1       0       0       0       0       1       0       0
                                              ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       1       0       0               0

                         NSTPS   NSTOL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000   -986.      -1

 STAGE      986.30     986.50     986.60     987.00     987.70     988.00     989.00     991.50     995.00    1000.00

  FLOW        0.00       1.40       2.00       3.10       4.50       4.90       6.20       6.60       7.20       7.90

SURFACE AREA=      10.      17.      28.      38.      46.      52.      56.      60.

   CAPACITY=        0.      23.      67.     133.     217.     315.     423.     539.

  ELEVATION=      986.     988.     990.     992.     994.     996.     998.    1000.

                       CREL   SPWID   COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                      986.3     0.0    0.0     0.0     0.0     0.0     0.0     0.0

                                                  DAM DATA
                                        TOPEL    COQD    EXPD  DAMWID
                                        998.8     0.0     0.0      0.
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STATION 3 POND, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.30	1	.50	2.	1.	1.	986.4
1.01	1.00	2	1.00	2.	1.	1.	986.4
1.01	1.30	3	1.50	2.	1.	1.	986.4
1.01	2.00	4	2.00	2.	1.	1.	986.4
1.01	2.30	5	2.50	2.	1.	1.	986.4
1.01	3.00	6	3.00	2.	1.	1.	986.4
1.01	3.30	7	3.50	1.	1.	1.	986.4
1.01	4.00	8	4.00	1.	1.	1.	986.4
1.01	4.30	9	4.50	1.	1.	1.	986.4
1.01	5.00	10	5.00	1.	1.	1.	986.4
1.01	5.30	11	5.50	1.	1.	1.	986.4
1.01	6.00	12	6.00	1.	1.	1.	986.4
1.01	6.30	13	6.50	2.	1.	1.	986.4
1.01	7.00	14	7.00	2.	1.	1.	986.4
1.01	7.30	15	7.50	2.	1.	1.	986.4
1.01	8.00	16	8.00	2.	1.	1.	986.4
1.01	8.30	17	8.50	2.	1.	1.	986.4
1.01	9.00	18	9.00	2.	1.	1.	986.4
1.01	9.30	19	9.50	2.	1.	2.	986.4
1.01	10.00	20	10.00	2.	1.	2.	986.5
1.01	10.30	21	10.50	2.	1.	2.	986.5
1.01	11.00	22	11.00	4.	1.	2.	986.5
1.01	11.30	23	11.50	8.	1.	2.	986.5
1.01	12.00	24	12.00	48.	2.	3.	986.6
1.01	12.30	25	12.50	109.	3.	6.	986.9
1.01	13.00	26	13.00	56.	3.	9.	987.1
1.01	13.30	27	13.50	31.	4.	11.	987.2
1.01	14.00	28	14.00	16.	4.	12.	987.3
1.01	14.30	29	14.50	12.	4.	12.	987.3
1.01	15.00	30	15.00	12.	4.	13.	987.4
1.01	15.30	31	15.50	10.	4.	13.	987.4
1.01	16.00	32	16.00	9.	4.	13.	987.4
1.01	16.30	33	16.50	9.	4.	13.	987.4
1.01	17.00	34	17.00	8.	4.	14.	987.4
1.01	17.30	35	17.50	8.	4.	14.	987.4
1.01	18.00	36	18.00	8.	4.	14.	987.4
1.01	18.30	37	18.50	8.	4.	14.	987.5
1.01	19.00	38	19.00	7.	4.	14.	987.5
1.01	19.30	39	19.50	6.	4.	14.	987.5
1.01	20.00	40	20.00	6.	4.	14.	987.5
1.01	20.30	41	20.50	5.	4.	14.	987.5
1.01	21.00	42	21.00	5.	4.	14.	987.5
1.01	21.30	43	21.50	4.	4.	14.	987.5
1.01	22.00	44	22.00	4.	4.	14.	987.5
1.01	22.30	45	22.50	4.	4.	15.	987.5
1.01	23.00	46	23.00	4.	4.	15.	987.5
1.01	23.30	47	23.50	4.	4.	15.	987.5
1.02	0.00	48	24.00	4.	4.	15.	987.5
1.02	.30	49	24.50	4.	4.	15.	987.5
1.02	1.00	50	25.00	4.	4.	15.	987.5
1.02	1.30	51	25.50	3.	4.	14.	987.5
1.02	2.00	52	26.00	3.	4.	14.	987.5
1.02	2.30	53	26.50	3.	4.	14.	987.5
1.02	3.00	54	27.00	2.	4.	14.	987.5
1.02	3.30	55	27.50	2.	4.	14.	987.5
1.02	4.00	56	28.00	2.	4.	14.	987.5
1.02	4.30	57	28.50	2.	4.	14.	987.5
1.02	5.00	58	29.00	2.	4.	14.	987.4
1.02	5.30	59	29.50	2.	4.	14.	987.4
1.02	6.00	60	30.00	1.	4.	14.	987.4
1.02	6.30	61	30.50	1.	4.	14.	987.4
1.02	7.00	62	31.00	1.	4.	14.	987.4
1.02	7.30	63	31.50	1.	4.	13.	987.4
1.02	8.00	64	32.00	1.	4.	13.	987.4
1.02	8.30	65	32.50	1.	4.	13.	987.4
1.02	9.00	66	33.00	1.	4.	13.	987.4
1.02	9.30	67	33.50	1.	4.	13.	987.4
1.02	10.00	68	34.00	1.	4.	13.	987.4
1.02	10.30	69	34.50	1.	4.	13.	987.4
1.02	11.00	70	35.00	1.	4.	13.	987.4
1.02	11.30	71	35.50	1.	4.	12.	987.3
1.02	12.00	72	36.00	0.	4.	12.	987.3
1.02	12.30	73	36.50	0.	4.	12.	987.3
1.02	13.00	74	37.00	0.	4.	12.	987.3
1.02	13.30	75	37.50	0.	4.	12.	987.3
1.02	14.00	76	38.00	0.	4.	12.	987.3
1.02	14.30	77	38.50	0.	4.	12.	987.3
1.02	15.00	78	39.00	0.	4.	12.	987.3
1.02	15.30	79	39.50	0.	4.	11.	987.3
1.02	16.00	80	40.00	0.	4.	11.	987.3
1.02	16.30	81	40.50	0.	4.	11.	987.2
1.02	17.00	82	41.00	0.	4.	11.	987.2
1.02	17.30	83	41.50	0.	4.	11.	987.2
1.02	18.00	84	42.00	0.	4.	11.	987.2
1.02	18.30	85	42.50	0.	4.	11.	987.2
1.02	19.00	86	43.00	0.	3.	10.	987.2
1.02	19.30	87	43.50	0.	3.	10.	987.2
1.02	20.00	88	44.00	0.	3.	10.	987.2
1.02	20.30	89	44.50	0.	3.	10.	987.2
1.02	21.00	90	45.00	0.	3.	10.	987.2
1.02	21.30	91	45.50	0.	3.	10.	987.1
1.02	22.00	92	46.00	0.	3.	10.	987.1
1.02	22.30	93	46.50	0.	3.	10.	987.1
1.02	23.00	94	47.00	0.	3.	9.	987.1
1.02	23.30	95	47.50	0.	3.	9.	987.1
1.03	0.00	96	48.00	0.	3.	9.	987.1
1.03	.30	97	48.50	0.	3.	9.	987.1
1.03	1.00	98	49.00	0.	3.	9.	987.1
1.03	1.30	99	49.50	0.	3.	9.	987.1
1.03	2.00	100	50.00	0.	3.	9.	987.1

PEAK OUTFLOW IS 4. AT TIME 24.50 HOURS

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**********          **********          **********          **********          **********

                                  SUB-AREA RUNOFF COMPUTATION

              INFLOW FROM LOWER WATERSHED TO DAM NO. 30717, SULLIVAN PRECIP, 30 MIN. INCR.

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        RUNOFF       0       0       0       0       0       1       0       0

                                          HYDROGRAPH DATA
              IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                  0       2    1.01    0.00    1.01    0.00   0.000       0       0       0

                                            PRECIP DATA
                                      NP   STORM     DAJ     DAK
                                     -48    0.00    0.00    0.00

                                             LOSS DATA
          LRUPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -57.00    0.00     .05

             CURVE NO =  -57.00  WETNESS =   -1.00  EFFECT CN =   57.00

                                          UNIT HYDROGRAPH DATA
                                      TC=  0.00     LAG=  2.40

                                            RECESSION DATA
                                STRTQ=  -10.00     QRCSN=    -.10     RTIOR= 2.50

           UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC=     0.00 HOURS, LAG=   2.40   VOL= 1.00
          17.        52.       110.       163.       184.       179.       156.       124.        85.        62.
          47.        35.        25.        19.        14.        10.         7.         5.         4.         3.
           2.         2.         1.         1.         1.         0.

     0                                           END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS    COMP Q      MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS     COMP Q

 1.01    .30       1     .03     .00     .03        9.       1.02   1.30      51    0.00    0.00    0.00        20.
 1.01   1.00       2     .03     .00     .03        9.       1.02   2.00      52    0.00    0.00    0.00        17.
 1.01   1.30       3     .03     .00     .03        8.       1.02   2.30      53    0.00    0.00    0.00        14.
 1.01   2.00       4     .03     .00     .03        8.       1.02   3.00      54    0.00    0.00    0.00        13.
 1.01   2.30       5     .03     .00     .03        7.       1.02   3.30      55    0.00    0.00    0.00        12.
 1.01   3.00       6     .03     .00     .03        7.       1.02   4.00      56    0.00    0.00    0.00        11.
 1.01   3.30       7     .03     .00     .03        7.       1.02   4.30      57    0.00    0.00    0.00        10.
 1.01   4.00       8     .03     .00     .03        6.       1.02   5.00      58    0.00    0.00    0.00         9.
 1.01   4.30       9     .03     .00     .03        6.       1.02   5.30      59    0.00    0.00    0.00         8.
 1.01   5.00      10     .03     .00     .03        6.       1.02   6.00      60    0.00    0.00    0.00         8.
 1.01   5.30      11     .03     .00     .03        5.       1.02   6.30      61    0.00    0.00    0.00         7.
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1.01	6.00	12	.03	.00	.03	5.	1.02	7.00	62	0.00	0.00	0.00	6.
1.01	6.30	13	.06	.00	.06	5.	1.02	7.30	63	0.00	0.00	0.00	6.
1.01	7.00	14	.06	.00	.06	5.	1.02	8.00	64	0.00	0.00	0.00	5.
1.01	7.30	15	.06	.00	.06	5.	1.02	8.30	65	0.00	0.00	0.00	5.
1.01	8.00	16	.06	.00	.06	5.	1.02	9.00	66	0.00	0.00	0.00	4.
1.01	8.30	17	.06	.00	.06	5.	1.02	9.30	67	0.00	0.00	0.00	4.
1.01	9.00	18	.06	.00	.06	5.	1.02	10.00	68	0.00	0.00	0.00	4.
1.01	9.30	19	.09	.00	.09	5.	1.02	10.30	69	0.00	0.00	0.00	3.
1.01	10.00	20	.09	.00	.09	5.	1.02	11.00	70	0.00	0.00	0.00	3.
1.01	10.30	21	.09	.00	.09	5.	1.02	11.30	71	0.00	0.00	0.00	3.
1.01	11.00	22	.19	.01	.18	6.	1.02	12.00	72	0.00	0.00	0.00	3.
1.01	11.30	23	.29	.01	.28	6.	1.02	12.30	73	0.00	0.00	0.00	2.
1.01	12.00	24	.96	.14	.82	9.	1.02	13.00	74	0.00	0.00	0.00	2.
1.01	12.30	25	1.27	.44	.83	23.	1.02	13.30	75	0.00	0.00	0.00	2.
1.01	13.00	26	.29	.13	.16	49.	1.02	14.00	76	0.00	0.00	0.00	2.
1.01	13.30	27	.19	.09	.10	87.	1.02	14.30	77	0.00	0.00	0.00	2.
1.01	14.00	28	.09	.04	.05	123.	1.02	15.00	78	0.00	0.00	0.00	1.
1.01	14.30	29	.09	.04	.05	145.	1.02	15.30	79	0.00	0.00	0.00	1.
1.01	15.00	30	.09	.05	.04	151.	1.02	16.00	80	0.00	0.00	0.00	1.
1.01	15.30	31	.06	.03	.03	143.	1.02	16.30	81	0.00	0.00	0.00	1.
1.01	16.00	32	.06	.03	.03	127.	1.02	17.00	82	0.00	0.00	0.00	1.
1.01	16.30	33	.06	.03	.03	107.	1.02	17.30	83	0.00	0.00	0.00	1.
1.01	17.00	34	.06	.03	.03	91.	1.02	18.00	84	0.00	0.00	0.00	1.
1.01	17.30	35	.06	.03	.03	79.	1.02	18.30	85	0.00	0.00	0.00	1.
1.01	18.00	36	.06	.03	.03	70.	1.02	19.00	86	0.00	0.00	0.00	1.
1.01	18.30	37	.03	.02	.01	62.	1.02	19.30	87	0.00	0.00	0.00	1.
1.01	19.00	38	.03	.02	.01	56.	1.02	20.00	88	0.00	0.00	0.00	1.
1.01	19.30	39	.03	.02	.01	50.	1.02	20.30	89	0.00	0.00	0.00	1.
1.01	20.00	40	.03	.02	.01	45.	1.02	21.00	90	0.00	0.00	0.00	0.
1.01	20.30	41	.03	.02	.01	40.	1.02	21.30	91	0.00	0.00	0.00	0.
1.01	21.00	42	.03	.02	.01	35.	1.02	22.00	92	0.00	0.00	0.00	0.
1.01	21.30	43	.03	.02	.01	32.	1.02	22.30	93	0.00	0.00	0.00	0.
1.01	22.00	44	.03	.02	.01	29.	1.02	23.00	94	0.00	0.00	0.00	0.
1.01	22.30	45	.03	.02	.01	27.	1.02	23.30	95	0.00	0.00	0.00	0.
1.01	23.00	46	.03	.02	.01	26.	1.03	0.00	96	0.00	0.00	0.00	0.
1.01	23.30	47	.03	.02	.01	25.	1.03	.30	97	0.00	0.00	0.00	0.
1.02	0.00	48	.03	.02	.01	24.	1.03	1.00	98	0.00	0.00	0.00	0.
1.02	.30	49	0.00	0.00	0.00	23.	1.03	1.30	99	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00	22.	1.03	2.00	100	0.00	0.00	0.00	0.
									SUM	5.17	1.39	3.77	2037.
										(131.)(	35.)(	96.)(	57.68)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	151.	103.	39.	20.	2033.
CMS	4.	3.	1.	1.	58.
INCHES		.95	1.44	1.55	1.55
MM		24.03	36.55	39.48	39.48
AC-FT		51.	78.	84.	84.
THOUS CU M		63.	96.	104.	104.

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COMBINE HYDROGRAPHS

COMBINATION OF OUTFLOW FROM UPPER LAKE AND RUNOFF OF LOWER WATERSHED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UP+LOW	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT UP+LOW PLAN 1 RTIO 1

10.	9.	9.	8.	8.	8.	8.	7.	7.	7.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	7.	7.	11.	25.	52.	91.	127.	149.	155.
147.	131.	111.	95.	83.	74.	66.	60.	54.	49.
44.	39.	36.	33.	31.	30.	29.	28.	27.	26.
24.	21.	19.	17.	16.	15.	14.	13.	12.	12.
11.	10.	10.	9.	9.	8.	8.	8.	7.	7.
7.	6.	6.	6.	6.	5.	5.	5.	5.	5.
5.	5.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	3.	3.	3.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	155.	107.	43.	25.	2340.
CMS	4.	3.	1.	1.	66.
INCHES		.85	1.36	1.55	1.55
MM		21.55	34.56	39.29	39.29
AC-FT		53.	85.	97.	97.
THOUS CU M		65.	105.	119.	119.

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HYDROGRAPH ROUTING

10-YR FLOOD ROUTING THROUGH LOWER POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
L POND	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-945.	-1

STAGE	944.00	944.80	945.50	946.50	947.90	949.30	950.70	952.10	954.80	957.50
FLOW	4.50	4.60	33.00	141.00	418.00	798.00	1269.00	1834.00	3237.00	5008.00

SURFACE AREA=	28.	40.	53.	62.	70.	80.	86.
CAPACITY=	0.	101.	241.	355.	487.	637.	762.
ELEVATION=	944.	947.	950.	952.	954.	956.	957.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
944.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
957.5	0.0	0.0	0.

STATION L POND, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.30	1	.50	10.	5.	24.	944.8
1.01	1.00	2	1.00	9.	5.	24.	944.8
1.01	1.30	3	1.50	9.	5.	24.	944.8
1.01	2.00	4	2.00	8.	6.	24.	944.8
1.01	2.30	5	2.50	8.	6.	24.	944.8
1.01	3.00	6	3.00	8.	6.	24.	944.8
1.01	3.30	7	3.50	8.	6.	25.	944.8
1.01	4.00	8	4.00	7.	6.	25.	944.8
1.01	4.30	9	4.50	7.	6.	25.	944.8
1.01	5.00	10	5.00	7.	6.	25.	944.8
1.01	5.30	11	5.50	6.	6.	25.	944.8
1.01	6.00	12	6.00	6.	6.	25.	944.8
1.01	6.30	13	6.50	6.	6.	25.	944.8
1.01	7.00	14	7.00	6.	6.	25.	944.8
1.01	7.30	15	7.50	6.	6.	25.	944.8
1.01	8.00	16	8.00	6.	6.	25.	944.8
1.01	8.30	17	8.50	6.	6.	25.	944.8
1.01	9.00	18	9.00	6.	6.	25.	944.8
1.01	9.30	19	9.50	6.	6.	25.	944.8
1.01	10.00	20	10.00	6.	6.	25.	944.8
1.01	10.30	21	10.50	6.	6.	25.	944.8
1.01	11.00	22	11.00	7.	6.	25.	944.8
1.01	11.30	23	11.50	7.	6.	25.	944.8
1.01	12.00	24	12.00	11.	6.	25.	944.8
1.01	12.30	25	12.50	25.	7.	25.	944.9
1.01	13.00	26	13.00	52.	9.	27.	944.9
1.01	13.30	27	13.50	91.	12.	29.	945.0
1.01	14.00	28	14.00	127.	17.	33.	945.1
1.01	14.30	29	14.50	149.	23.	38.	945.3
1.01	15.00	30	15.00	155.	29.	43.	945.4
1.01	15.30	31	15.50	147.	39.	48.	945.6
1.01	16.00	32	16.00	131.	51.	52.	945.7
1.01	16.30	33	16.50	111.	59.	55.	945.7
1.01	17.00	34	17.00	95.	65.	56.	945.8
1.01	17.30	35	17.50	83.	67.	57.	945.8
1.01	18.00	36	18.00	74.	69.	58.	945.8
1.01	18.30	37	18.50	66.	69.	58.	945.8
1.01	19.00	38	19.00	60.	68.	57.	945.8
1.01	19.30	39	19.50	54.	67.	57.	945.8
1.01	20.00	40	20.00	49.	65.	56.	945.8
1.01	20.30	41	20.50	44.	63.	56.	945.8
1.01	21.00	42	21.00	39.	60.	55.	945.8
1.01	21.30	43	21.50	36.	57.	54.	945.7
1.01	22.00	44	22.00	33.	55.	53.	945.7
1.01	22.30	45	22.50	31.	52.	52.	945.7
1.01	23.00	46	23.00	30.	49.	51.	945.7
1.01	23.30	47	23.50	29.	47.	51.	945.6
1.02	0.00	48	24.00	28.	45.	50.	945.6
1.02	.30	49	24.50	27.	43.	49.	945.6
1.02	1.00	50	25.00	26.	41.	49.	945.6
1.02	1.30	51	25.50	24.	39.	48.	945.6
1.02	2.00	52	26.00	21.	37.	47.	945.5
1.02	2.30	53	26.50	19.	35.	47.	945.5
1.02	3.00	54	27.00	17.	33.	46.	945.5
1.02	3.30	55	27.50	16.	32.	45.	945.5
1.02	4.00	56	28.00	15.	31.	45.	945.5
1.02	4.30	57	28.50	14.	30.	44.	945.4
1.02	5.00	58	29.00	13.	30.	43.	945.4
1.02	5.30	59	29.50	12.	29.	43.	945.4
1.02	6.00	60	30.00	12.	28.	42.	945.4
1.02	6.30	61	30.50	11.	27.	41.	945.4
1.02	7.00	62	31.00	10.	26.	41.	945.3
1.02	7.30	63	31.50	10.	26.	40.	945.3
1.02	8.00	64	32.00	9.	25.	39.	945.3
1.02	8.30	65	32.50	9.	24.	39.	945.3
1.02	9.00	66	33.00	8.	23.	38.	945.3
1.02	9.30	67	33.50	8.	22.	38.	945.2
1.02	10.00	68	34.00	8.	22.	37.	945.2
1.02	10.30	69	34.50	7.	21.	36.	945.2
1.02	11.00	70	35.00	7.	20.	36.	945.2
1.02	11.30	71	35.50	7.	20.	35.	945.2
1.02	12.00	72	36.00	6.	19.	35.	945.2
1.02	12.30	73	36.50	6.	18.	34.	945.1
1.02	13.00	74	37.00	6.	18.	34.	945.1
1.02	13.30	75	37.50	6.	17.	33.	945.1
1.02	14.00	76	38.00	5.	17.	33.	945.1
1.02	14.30	77	38.50	5.	16.	32.	945.1
1.02	15.00	78	39.00	5.	15.	32.	945.1
1.02	15.30	79	39.50	5.	15.	32.	945.1
1.02	16.00	80	40.00	5.	14.	31.	945.0
1.02	16.30	81	40.50	5.	14.	31.	945.0
1.02	17.00	82	41.00	5.	13.	30.	945.0
1.02	17.30	83	41.50	4.	13.	30.	945.0
1.02	18.00	84	42.00	4.	13.	30.	945.0
1.02	18.30	85	42.50	4.	12.	29.	945.0
1.02	19.00	86	43.00	4.	12.	29.	945.0
1.02	19.30	87	43.50	4.	11.	29.	945.0
1.02	20.00	88	44.00	4.	11.	28.	945.0
1.02	20.30	89	44.50	4.	11.	28.	944.9
1.02	21.00	90	45.00	4.	10.	28.	944.9
1.02	21.30	91	45.50	4.	10.	28.	944.9
1.02	22.00	92	46.00	4.	10.	27.	944.9

1.02	22.30	93	46.50	4.	9.	27.	944.9
1.02	23.00	94	47.00	4.	9.	27.	944.9
1.02	23.30	95	47.50	4.	9.	27.	944.9
1.03	0.00	96	48.00	4.	8.	27.	944.9
1.03	.30	97	48.50	4.	8.	26.	944.9
1.03	1.00	98	49.00	3.	8.	26.	944.9
1.03	1.30	99	49.50	3.	8.	26.	944.9
1.03	2.00	100	50.00	3.	8.	26.	944.9

PEAK OUTFLOW IS 69. AT TIME 18.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	69.	63.	39.	23.	2295.
CMS	2.	2.	1.	1.	65.
INCHES		.50	1.22	1.52	1.52
MM		12.79	31.05	38.53	38.53
AC-FT		31.	76.	95.	95.
THOUS CU M		39.	94.	117.	117.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
HYDROGRAPH AT	INFLOW	.16	1	109.
	(	.41)	(	3.10)(
ROUTED TO	U POND	.16	1	4.
	(	.41)	(	.12)(
HYDROGRAPH AT	RUNOFF	1.01	1	151.
	(	2.63)	(	4.27)(
2 COMBINED	UP+LOW	1.17	1	155.
	(	3.04)	(	4.38)(
ROUTED TO	L POND	1.17	1	69.
	(	3.04)	(	1.95)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....10-yr.....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	986.40	986.30	998.80
STORAGE	1.	0.	468.
OUTFLOW	1.	0.	8.

MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
987.48	0.00	15.	4.	0.00	24.50	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....10-yr.....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	944.80	944.80	957.50
STORAGE	24.	24.	762.
OUTFLOW	5.	5.	5008.

MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
945.83	0.00	58.	69.	0.00	18.50	0.00

APPENDIX B

INFORMATION SUPLIED BY ST. JOE MINERALS CORPORATION

ST.JOE
MINERALS CORPORATION
P. O. Box 500
Viburnum, MO 65566

May 4, 1979

Mr. Jim Gray
Associate Geotechnical Engineer
International Engineering Co., Inc.
220 Montgomery Street
San Francisco, CA 94104

Dear Mr. Gray:

Enclosed are the materials you requested during our telephone conversation on May 2, 1979: 1) Summary of Tailings Disposal, 2) GECO Tailings Dam drawing dated 11-28-52, and 3) Location of Tailings Disposal Dam drawing dated 8-11-52.

In response to your question concerning size distribution of tailings in the dam, samples were taken at three points along the dam yielding the following average results (screen sizes are Tyler):

+48 mesh	6.3%
+65 mesh	13.5%
+100 mesh	19.3%
+150 mesh	20.3%
+200 mesh	13.1%
-200 mesh	27.5%

Regarding composition of the tailings, chemical analysis of the 1978 yearly composite shows the following:

$CaCO_3$	35.52%
$MgCO_3$	26.35%
Silicon	13.3%
Iron	2.7%
Aluminum	.51%
Sulfur	1.0%

Minor amounts of lead, copper and others. When Si and Al are converted to their natural silicote forms, these percentages equal greater than 95% of the total.

I am enclosing an aerial photo of the plant site and disposal area as it appeared in 1955. If you have further questions or need more information, feel free to contact me.

Sincerely,

John E. Kennedy

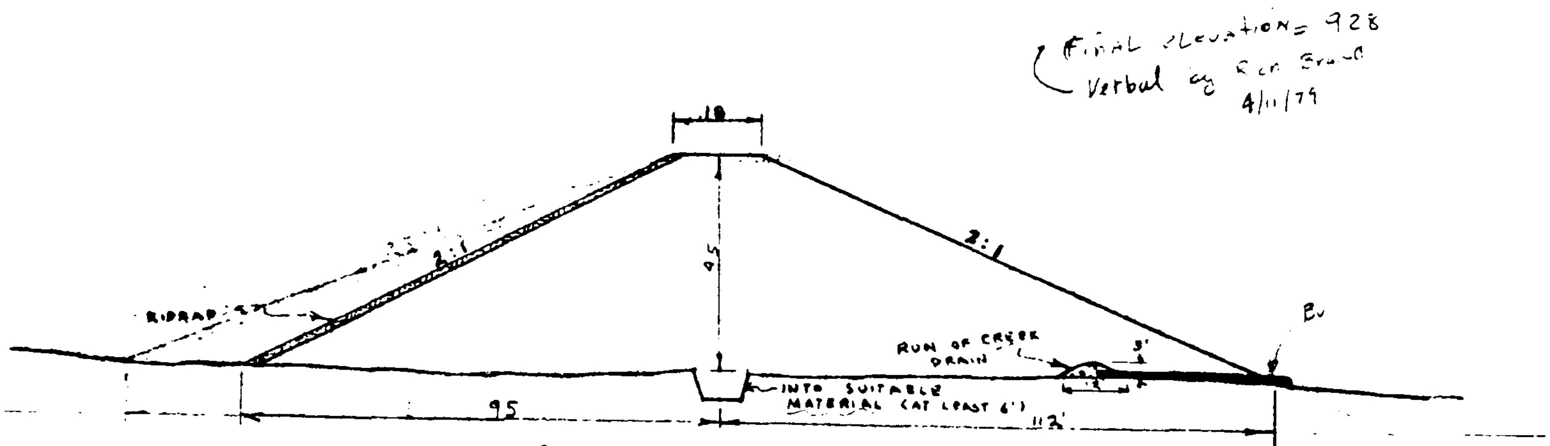
John E. Kennedy
Director of Environmental Control

SUMMARY OF INDIAN CREEK TAILINGS DISPOSAL

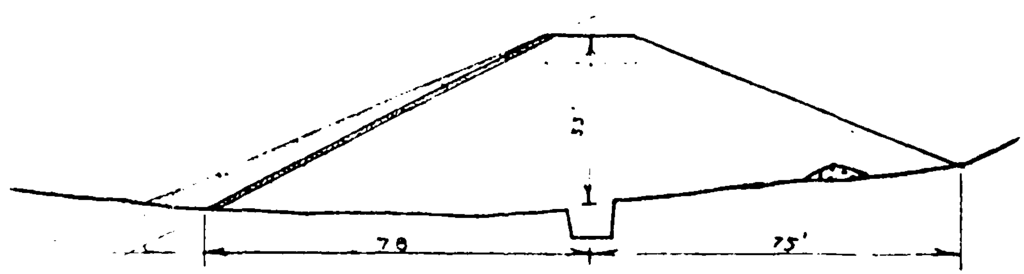
The Indian Creek Division tailings impoundment area was originally designed to utilize an earthen dam across the mouth of the valley with the tailings flowing by gravity to the containment area and clarified water discharging through a concrete spillway located at the end of the dam. This original earthen dam, constructed by locally available materials excluding soils containing large amounts of rock and gravel, was completed in the third quarter of 1953. In 1956, 1957, 1959 and 1960, this dam was raised several feet using additional material from the area. In 1961, cycloned tailings were used to construct an intermediate dam approximately 1,000 yards upstream from the earthen dam. Between 1961 and 1971, this dam was raised several times using tailings. In 1971, cycloned tailings were used to construct the present lower dam immediately upstream from and partially upon the earthen structure. Construction of this dam continued through 1976, which marked the end of construction activity at the lower end of the valley. From 1977 to the present, cycloned tailings have been used in the valley-side dam still under construction.

There were two exceptional events connected with the original earthen dam. In 1959, the spillway washed out following a seven-inch rainfall. Although some tailings escaped to the valley below, there was no damage to the dam itself. In 1960, the earthen dam began showing signs of "slump" failure, so it was raised and widened with local materials and strengthened by placing crushed rock at the toe. The integrity of the dam was maintained at all times.

RECEIVED FROM ST JOE
MINERALS CORP BY SECO



SECTION AT WIDEST POINT

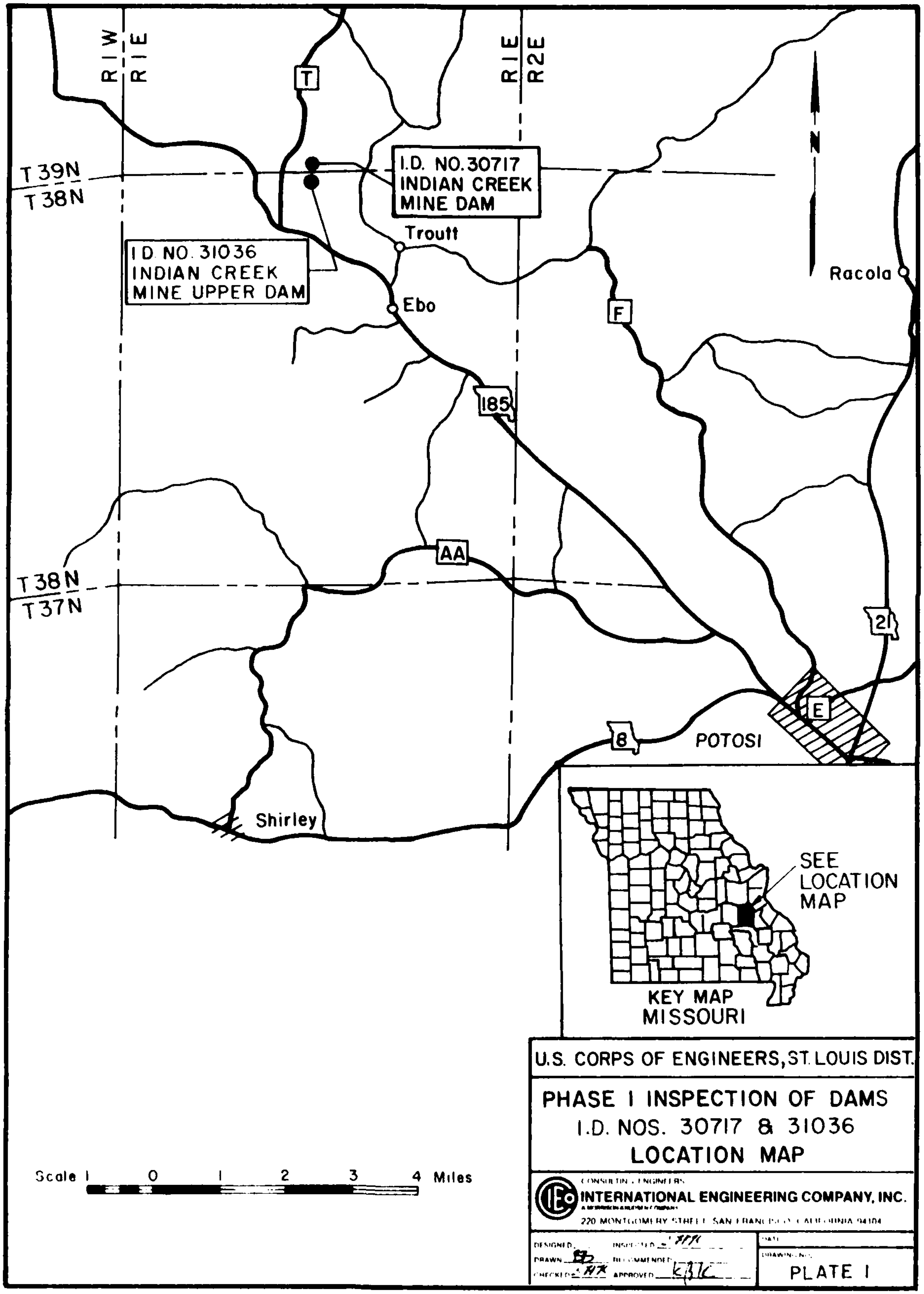


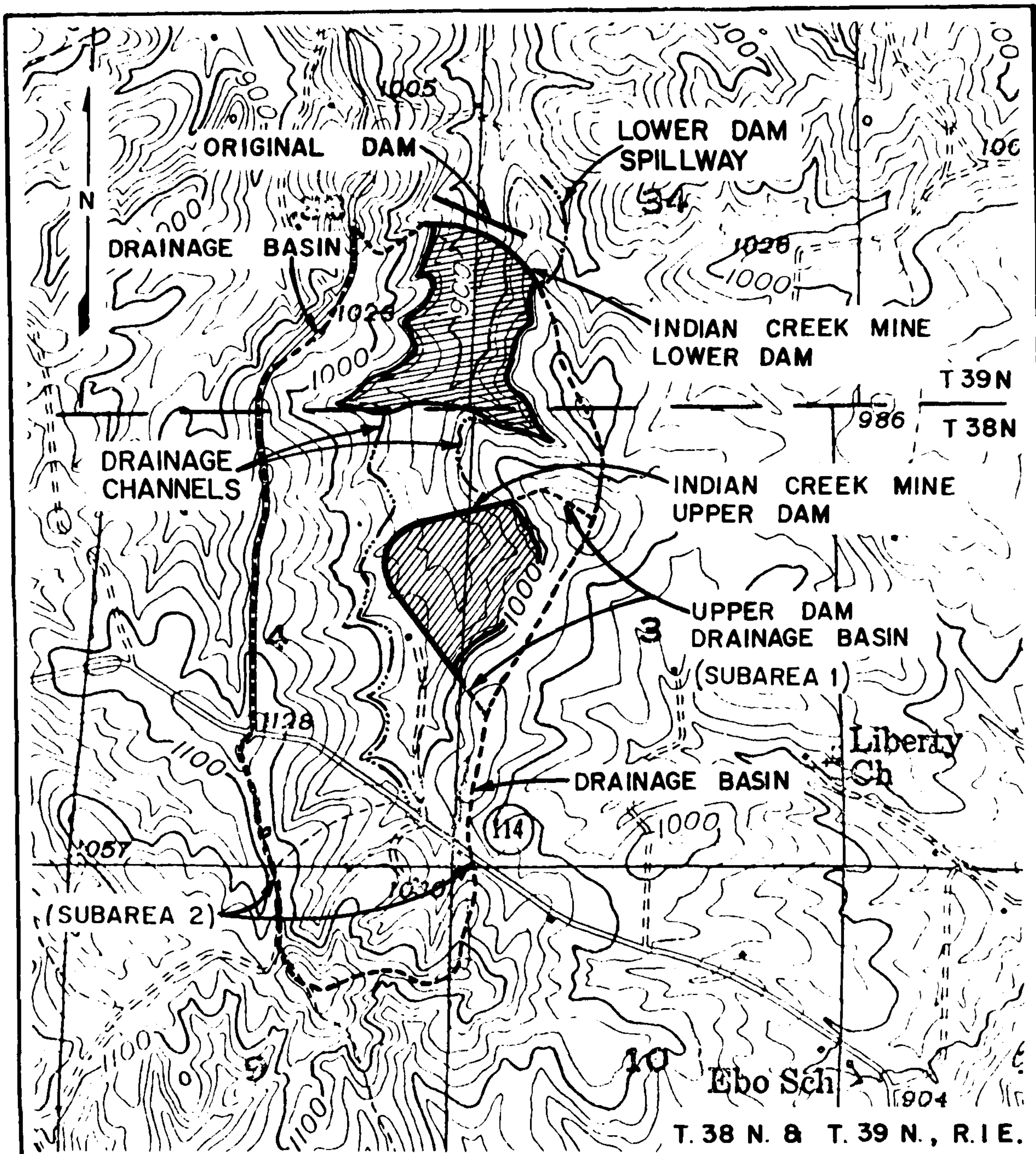
SECTION 500' WEST OF SECTION LINE

TYPICAL SECTIONS TAILINGS DAM

Received from
St. Joe Minerals Corp.
11 April 1979
Indian Creek Mine
Lower Dam
I.D. No. 30717

AUG. 11 1952
REVISED SEPT 17 '52


R1W
R1E
R1E
R2E
T
T39N
T38N
I.D. NO. 30717
INDIAN CREEK
MINE DAM
I.D. NO. 31036
INDIAN CREEK
MINE UPPER DAM
Troutt
Ebo
Racola
F
185
AA
T38N
T37N
21
E
8
POTOSI
Shirley
SEE
LOCATION
MAP
KEY MAP
MISSOURI
Scale 1 0 1 2 3 4 Miles
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.
PHASE I INSPECTION OF DAMS
I.D. NOS. 30717 & 31036
LOCATION MAP
CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO, CALIFORNIA 94104
DESIGNED
INSPECTED
DRAWN
RECOMMENDED
CHECKED
APPROVED
DATE
DRAWING NO.
PLATE 1



SUBAREA 1 - Watershed above Upper Dam (31036)

SUBAREA 2 - Watershed above Lower Dam (30717)

Scale 1000 0 1000 2000 3000 4000 Feet

US. CORPS OF ENGINEERS, ST. LOUIS DIST.

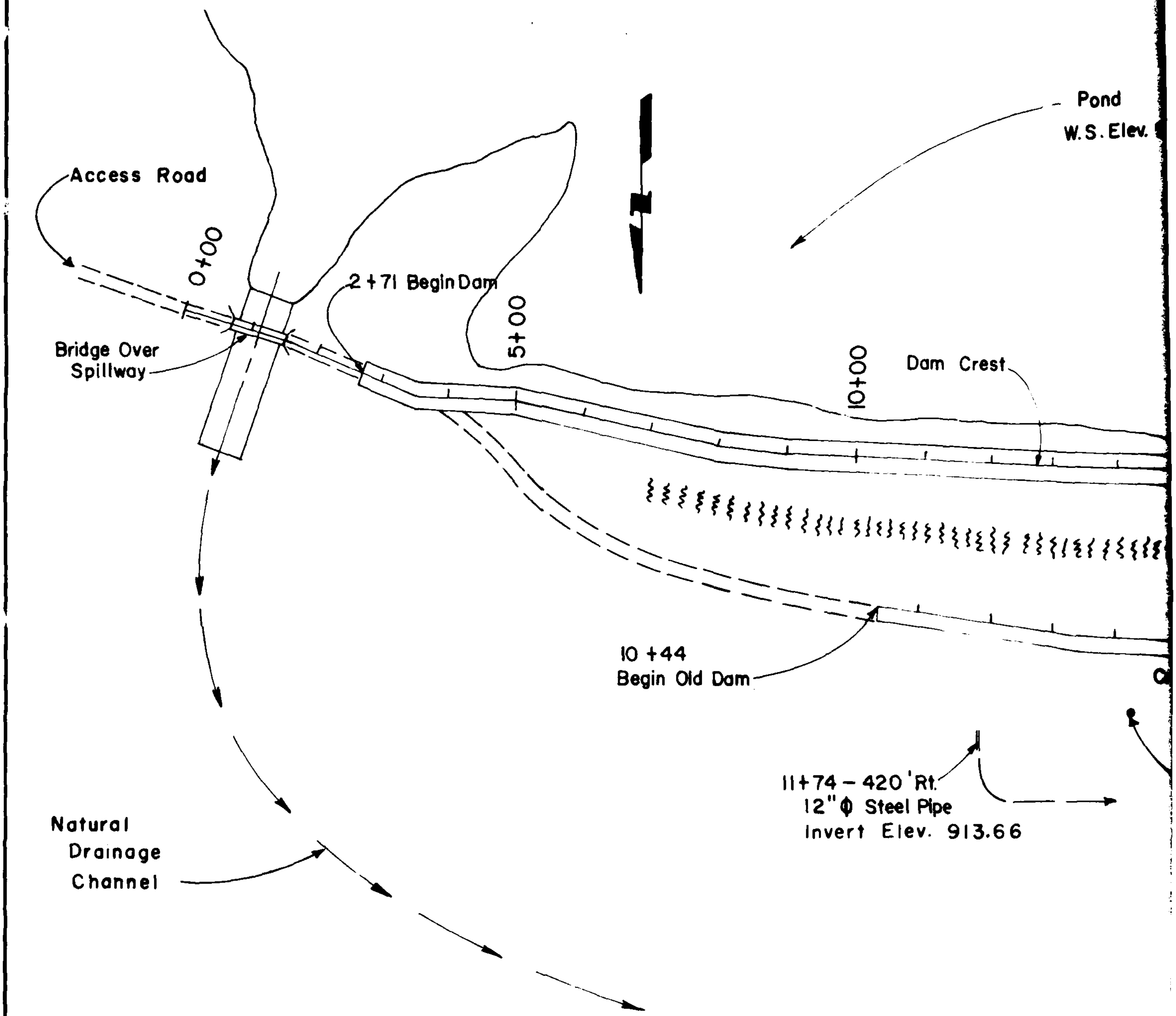
PHASE I INSPECTION OF DAMS

I.D. NOS. 30717 & 31036

VICINITY TOPOGRAPHY

INTERNATIONAL ENGINEERING COMPANY, INC.

PLATE 2



B.M. – 60 d Spike in Root of 24"
White Oak 30' Rt. of Sta. 3+70
Elev. 966.06
B. M. established by St. Joe Lead Co.

Note: Upstream end of outlet pipe is located approximately 1000 feet south of the dam crest at approximately STA. 12+00

Date of Survey – 4/18/79

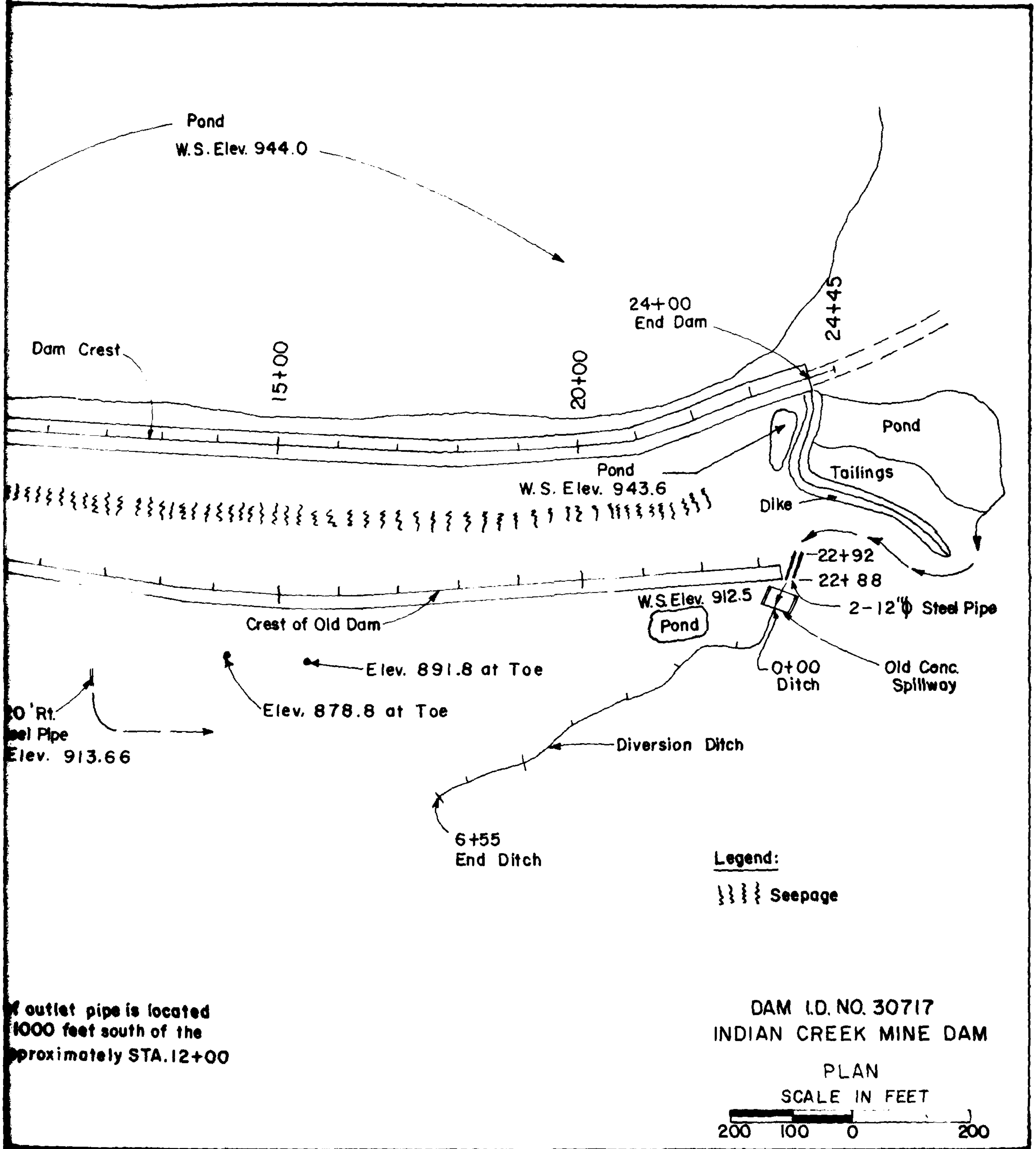
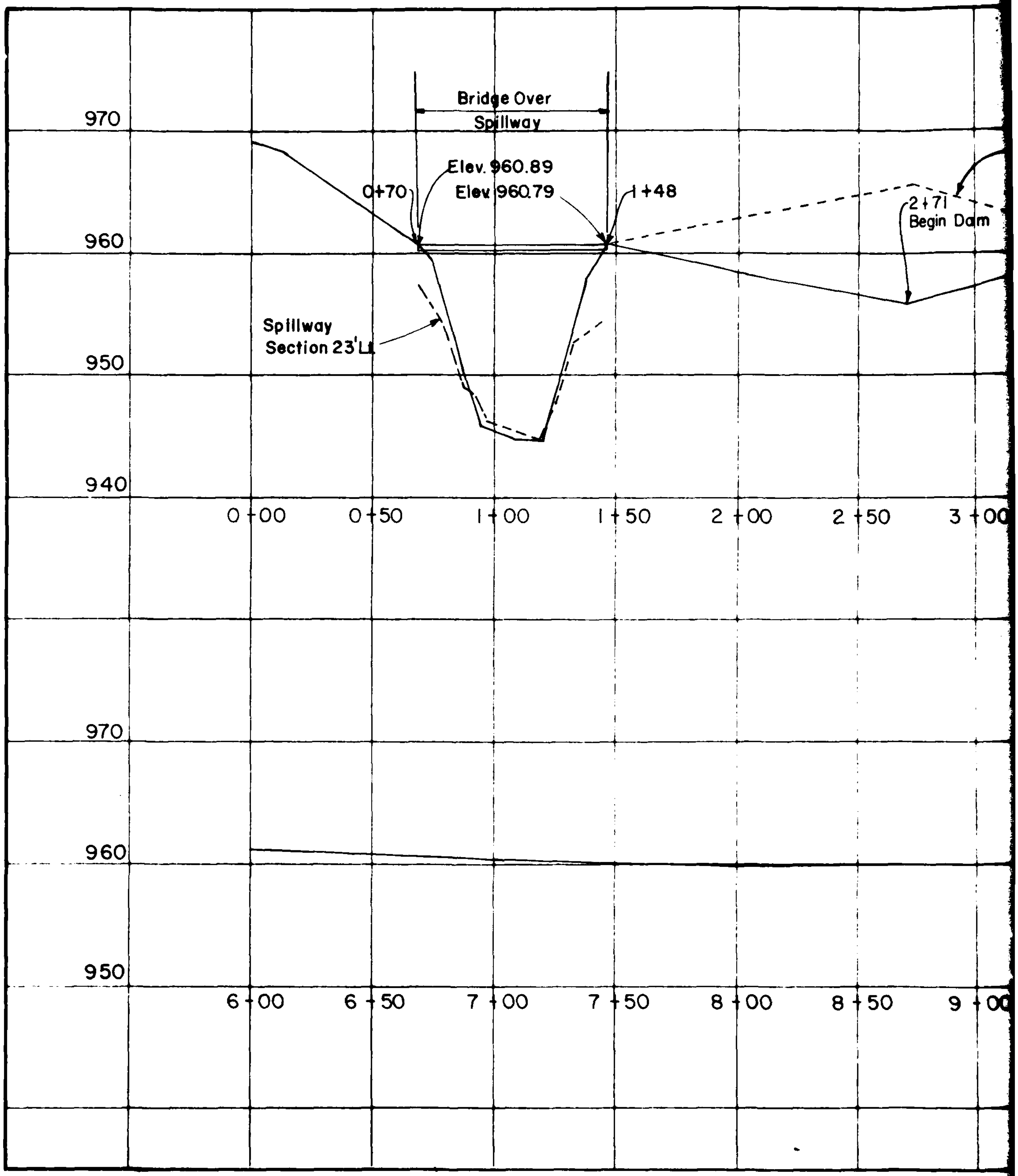
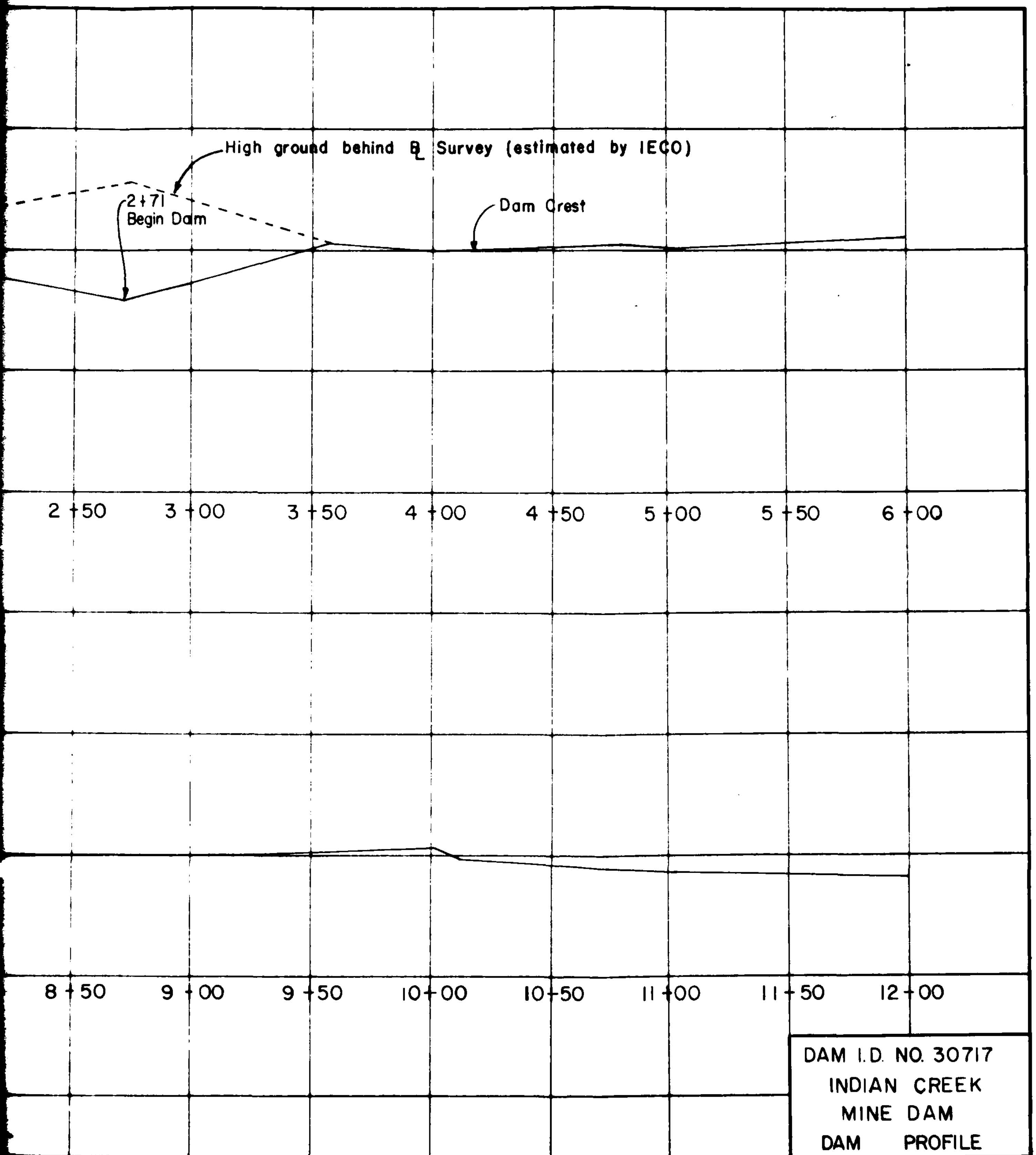

Pond
W.S. Elev. 944.0
24+00
End Dam
24+45
Dam Crest
15+00
20+00
Pond
Tailings
Pond
W. S. Elev. 943.6
Dike
22+92
22+88
2-12"ϕ Steel Pipe
W.S.Elev. 912.5
Pond
Crest of Old Dam
Elev. 891.8 at Toe
0+00
Ditch
Old Conc.
Spillway
0'Rt.
el Pipe
Elev. 913.66
Elev. 878.8 at Toe
Diversion Ditch
6+55
End Ditch
Legend:
Seepage
outlet pipe is located
1000 feet south of the
pproximately STA.12+00
DAM I.D. NO. 30717
INDIAN CREEK MINE DAM
PLAN
SCALE IN FEET
200 100 0 200

PLATE 3



970
960
950
940
Bridge Over
Spillway
Elev. 960.89
Elev. 960.79
0+70
1+48
2+71
Begin Dam
Spillway
Section 23' Lt
0+00
0+50
1+00
1+50
2+00
2+50
3+00
970
960
950
6+00
6+50
7+00
7+50
8+00
8+50
9+00

1

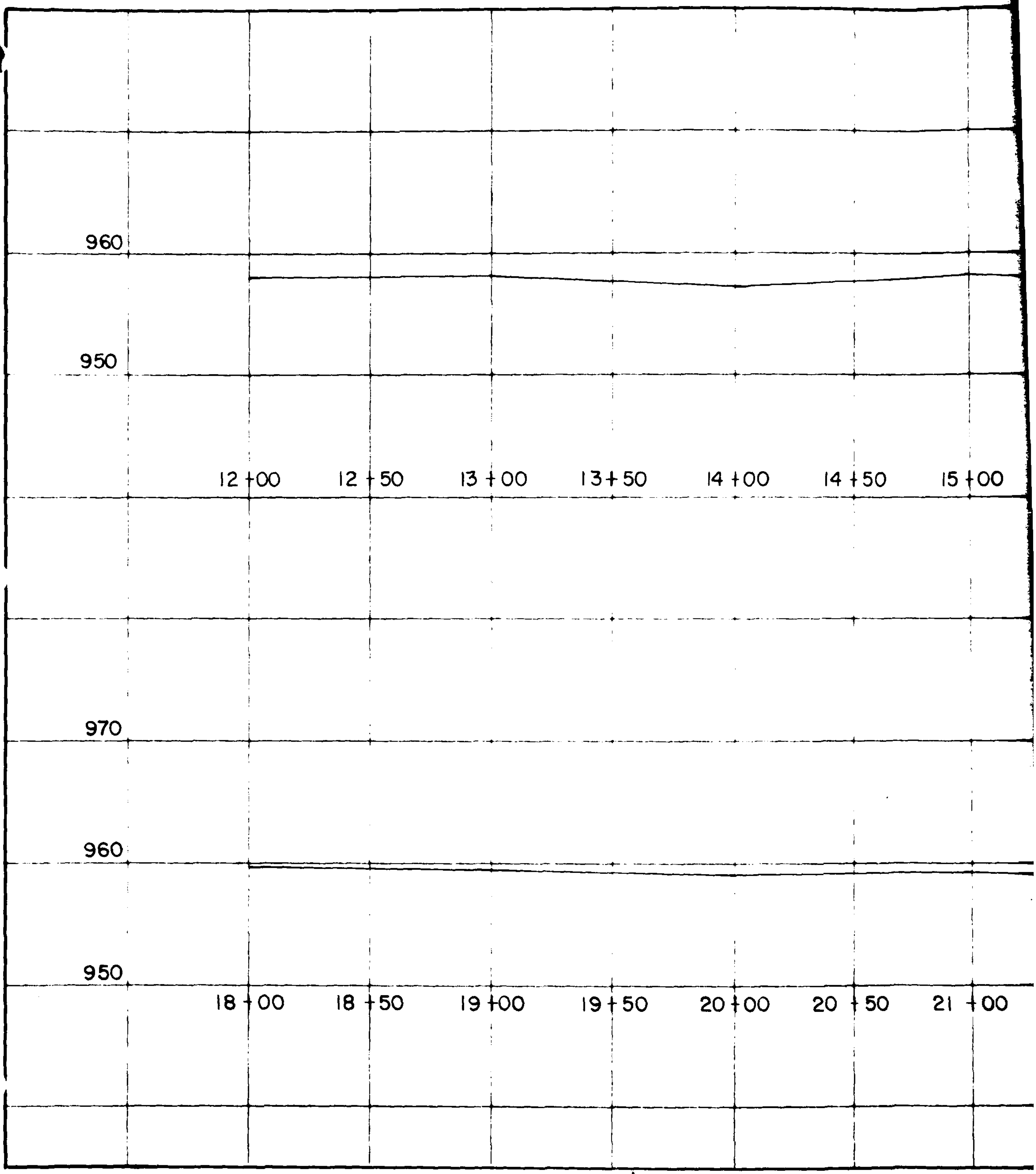


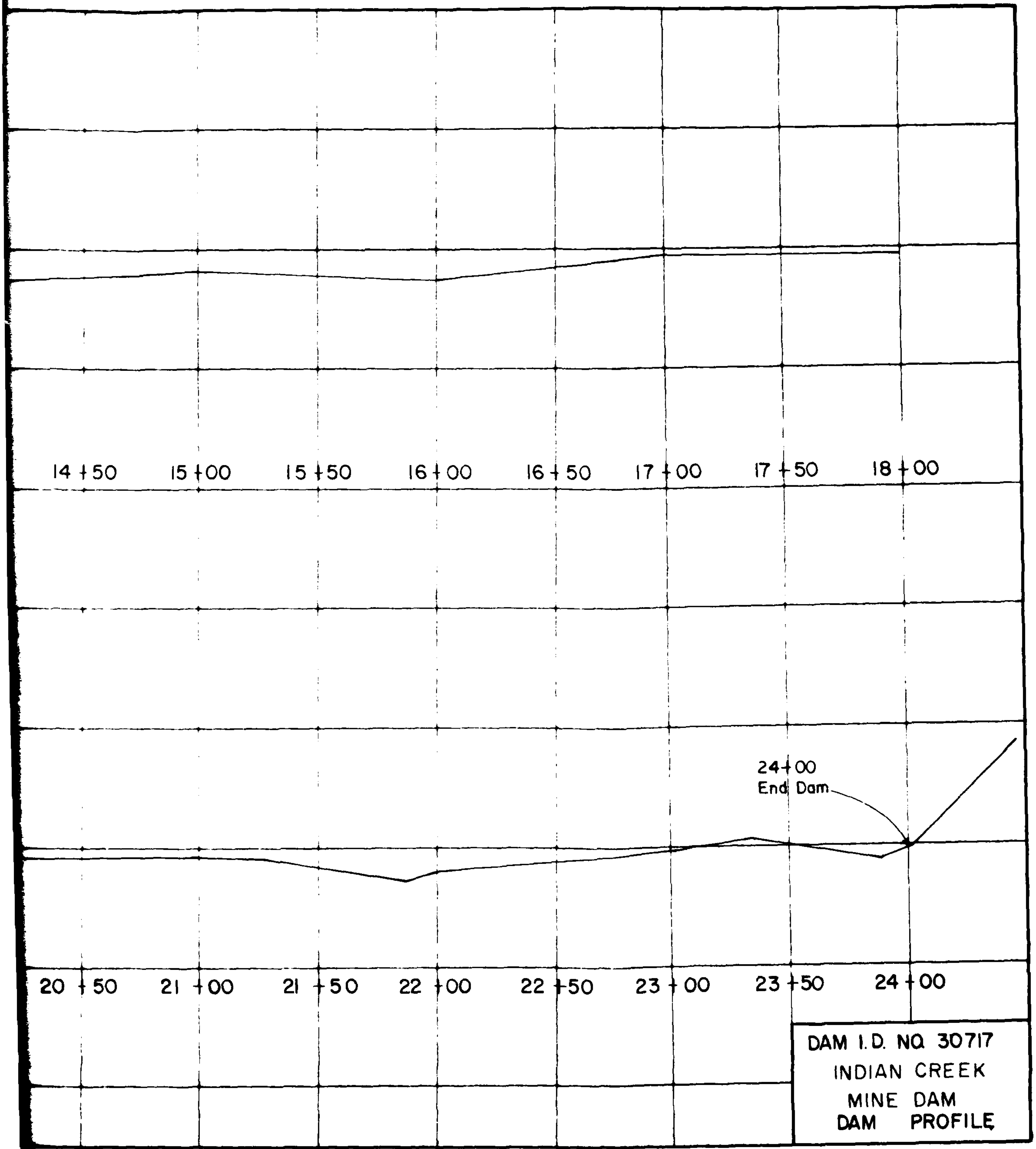
DAM I.D. NO. 30717
INDIAN CREEK
MINE DAM
DAM PROFILE

PLATE 4A

1

2


960
950
12+00
12+50
13+00
13+50
14+00
14+50
15+00
970
960
950
18+00
18+50
19+00
19+50
20+00
20+50
21+00

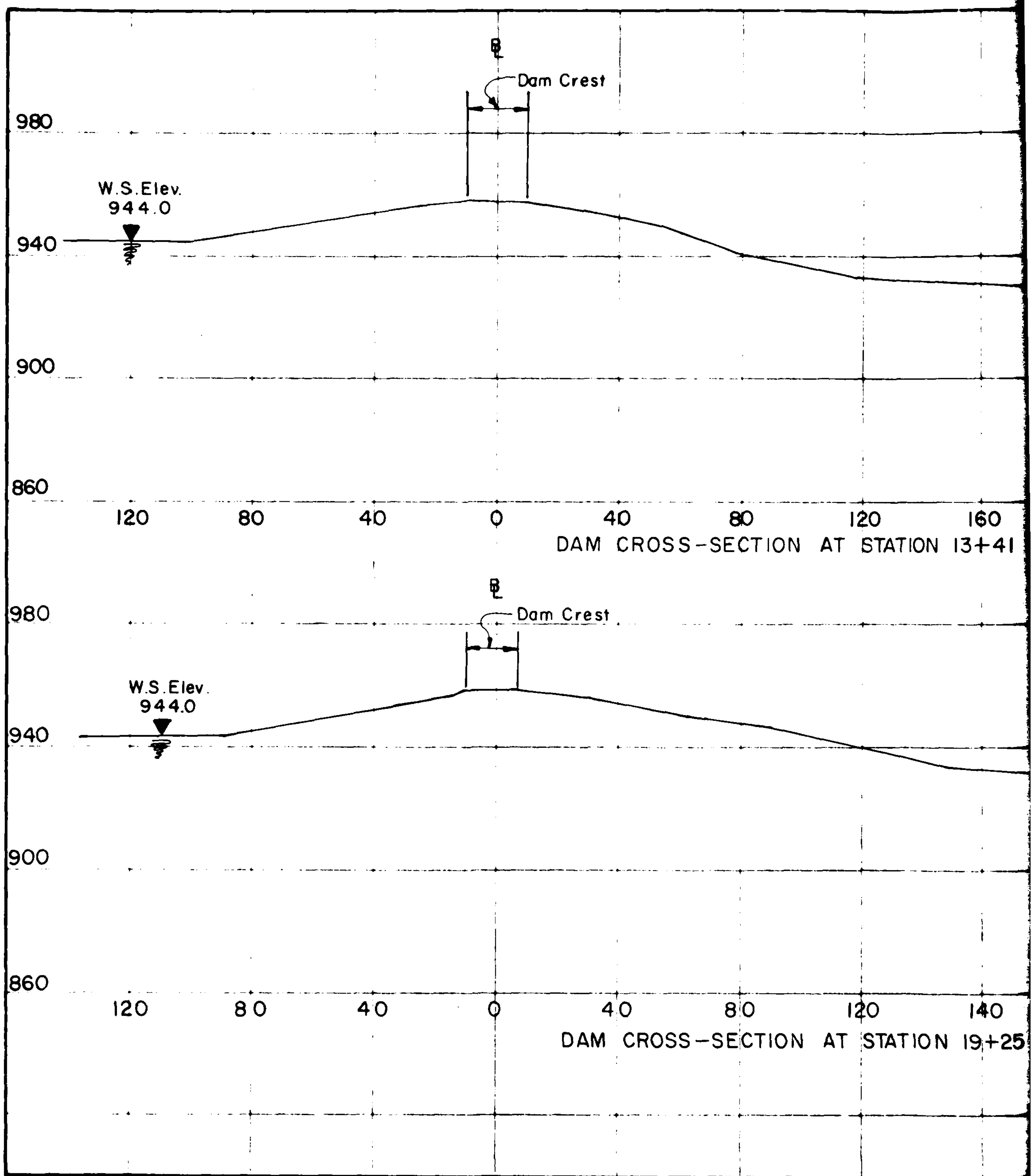


DAM I.D. NO. 30717
INDIAN CREEK
MINE DAM
DAM PROFILE

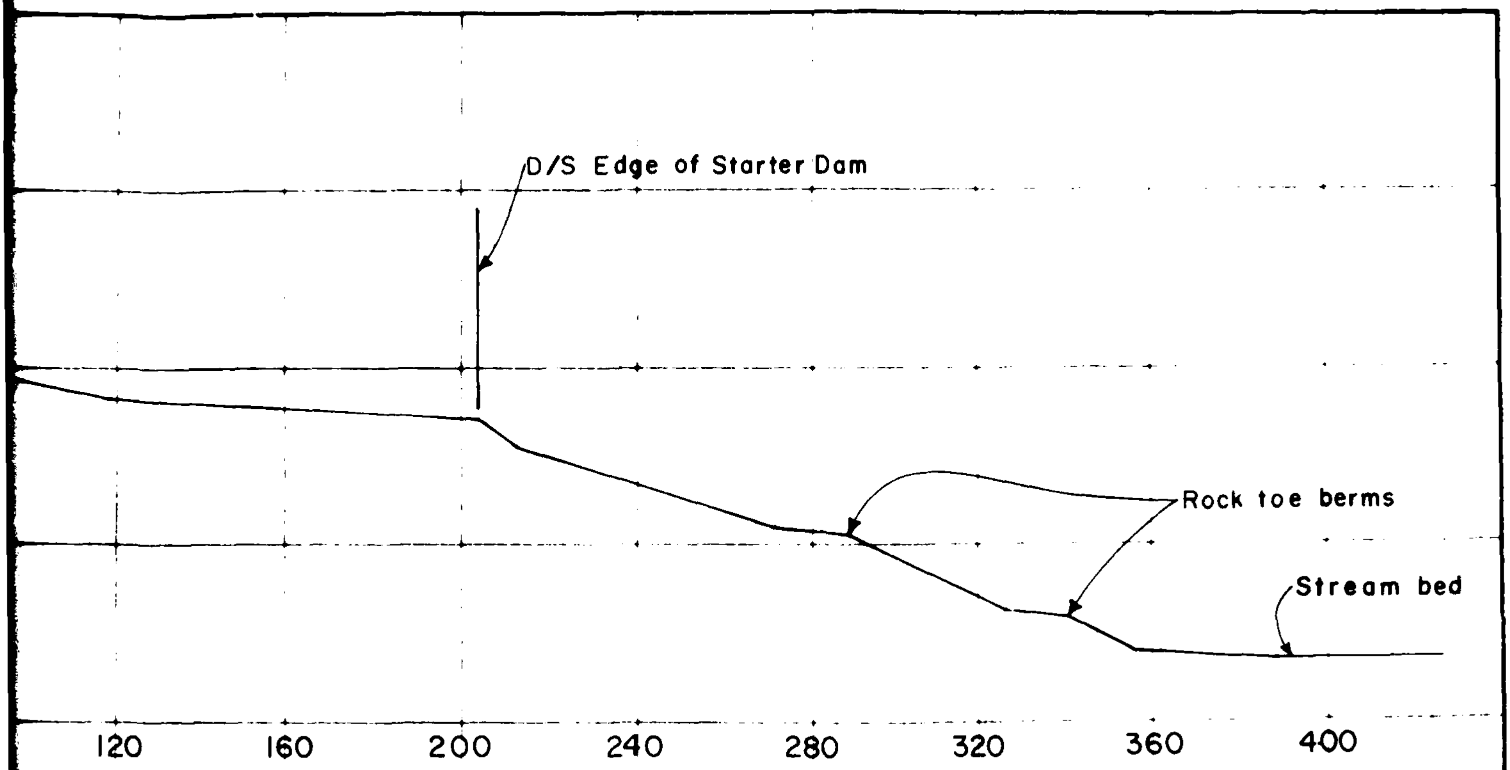
PLATE 4B

1

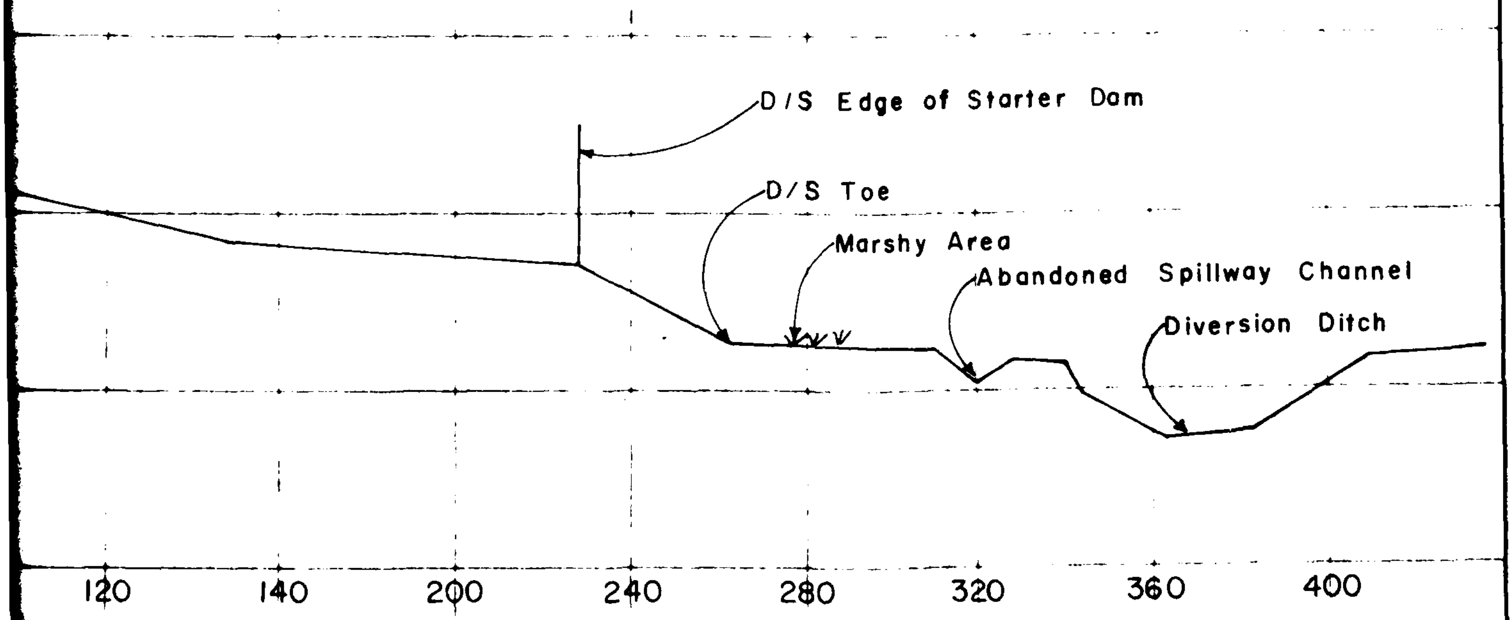
2



Dam Crest
980
940
900
860
W.S.Elev.
944.0
120
80
40
0
40
80
120
160
DAM CROSS-SECTION AT STATION 13+41
Dam Crest
980
940
900
860
W.S.Elev.
944.0
120
80
40
0
40
80
120
140
DAM CROSS-SECTION AT STATION 19+25



AT STATION 13+41



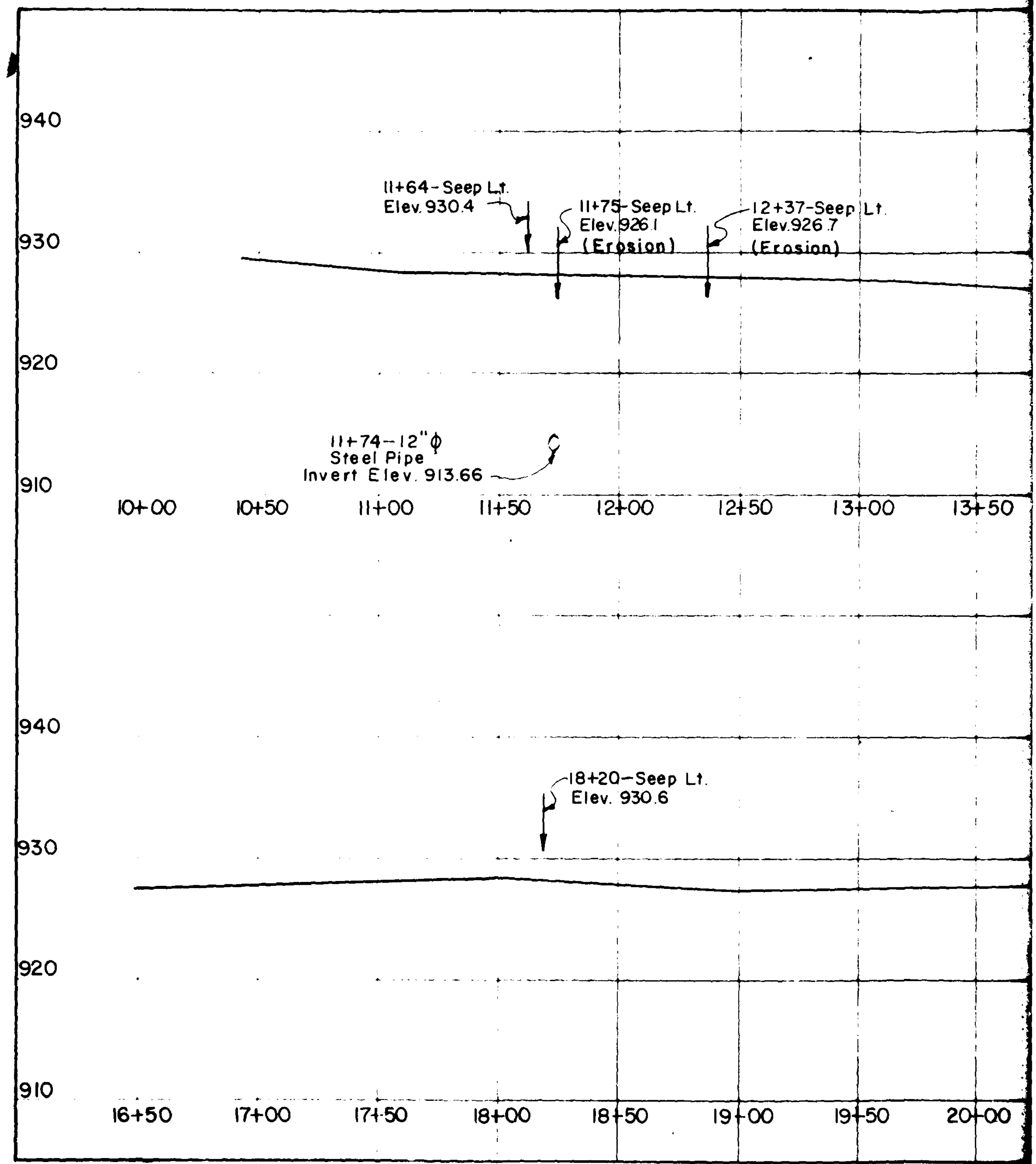
AT STATION 19+25

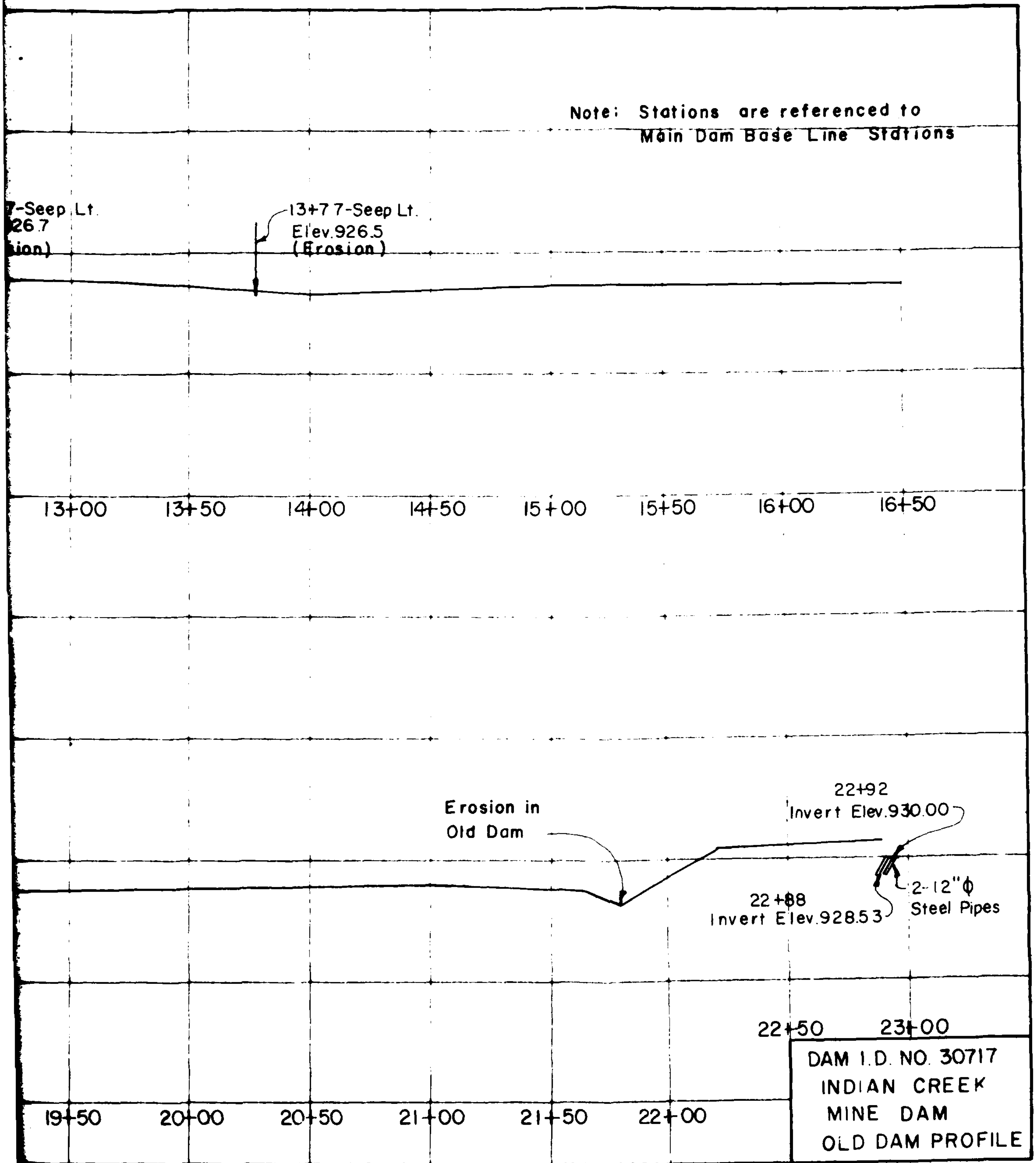
DAM I.D. NO. 30717
INDIAN CREEK
MINE DAM
DAM CROSS-SECTIONS

PLATE 5

1

2


940
930
920
910
11+64-Seep Lt.
Elev. 930.4
11+75-Seep Lt.
Elev. 926.1
(Erosion)
12+37-Seep Lt.
Elev. 926.7
(Erosion)
11+74-12" ϕ
Steel Pipe
Invert Elev. 913.66
10+00
10+50
11+00
11+50
12+00
12+50
13+00
13+50
940
930
920
910
18+20-Seep Lt.
Elev. 930.6
16+50
17+00
17+50
18+00
18+50
19+00
19+50
20+00

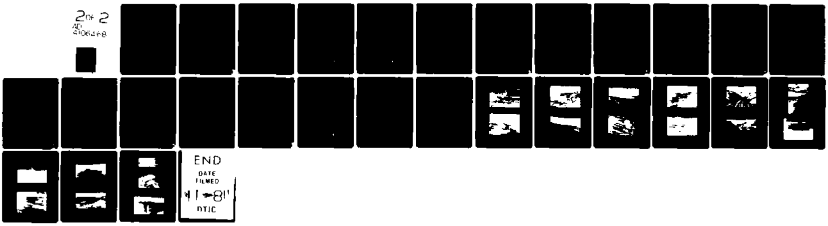


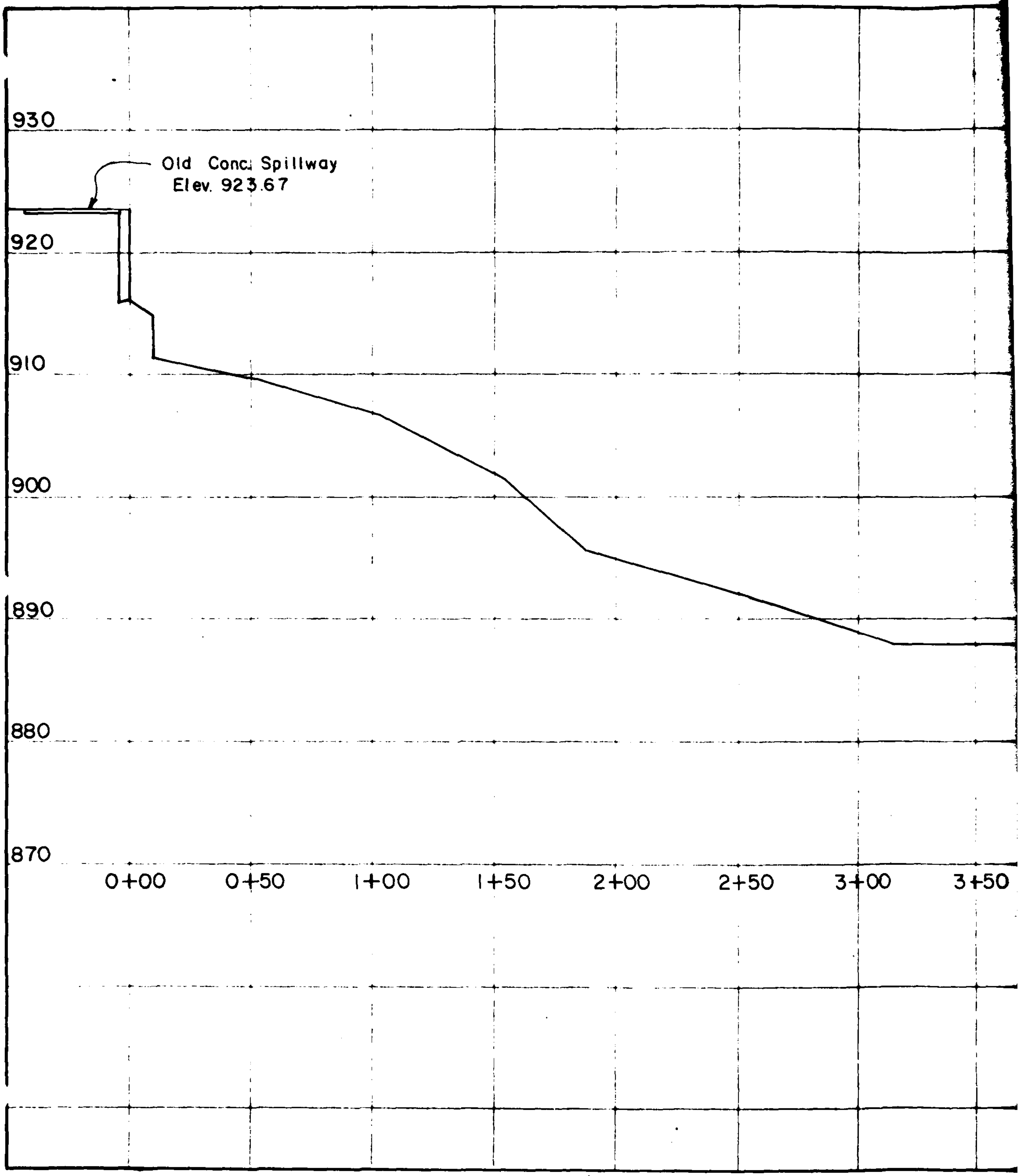
DAM I.D. NO. 30717
INDIAN CREEK
MINE DAM
OLD DAM PROFILE

PLATE 6

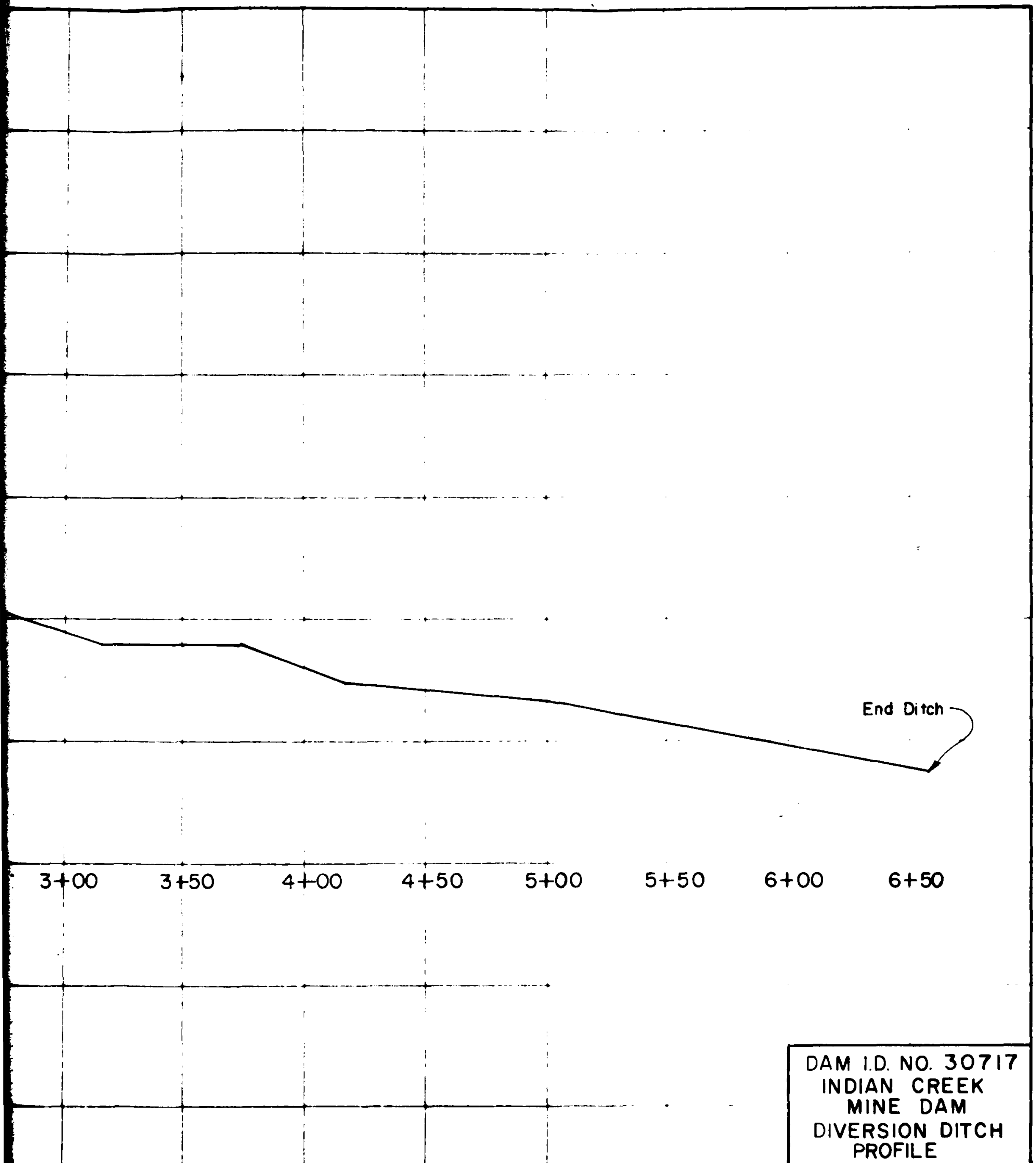
AD-A106 468 INTERNATIONAL ENGINEERING CO INC SAN FRANCISCO CA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. INDIAN CREEK MINE DAMS (MO 30717 A--ETC(U)
FEB 80 K B KING, J H GRAY, D E WESTCOTT DACW43-79-C-0037

UNCLASSIFIED NL





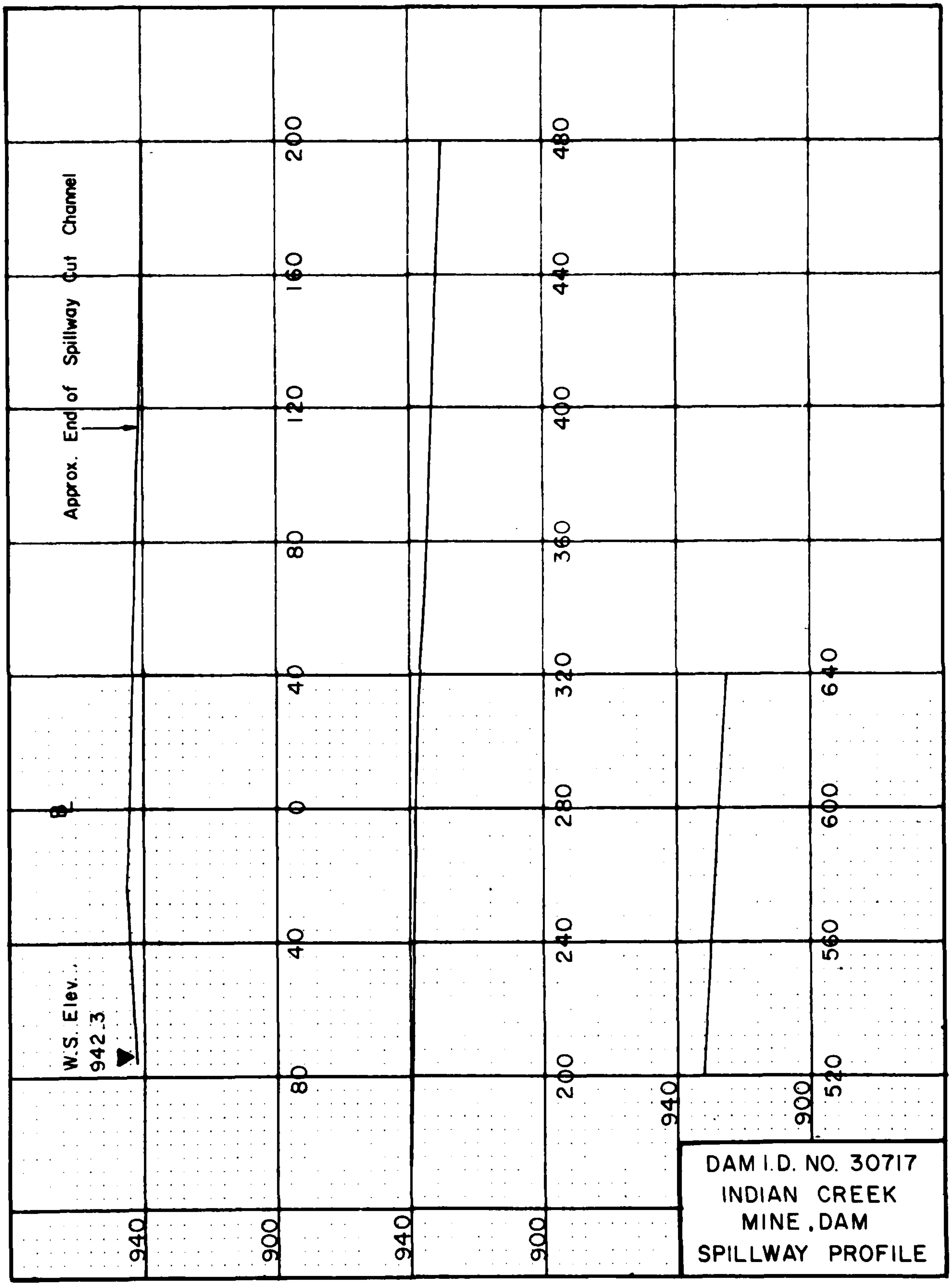
Old Conc. Spillway
Elev. 923.67
930
920
910
900
890
880
870
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50



DAM I.D. NO. 30717
INDIAN CREEK
MINE DAM
DIVERSION DITCH
PROFILE

PLATE 7

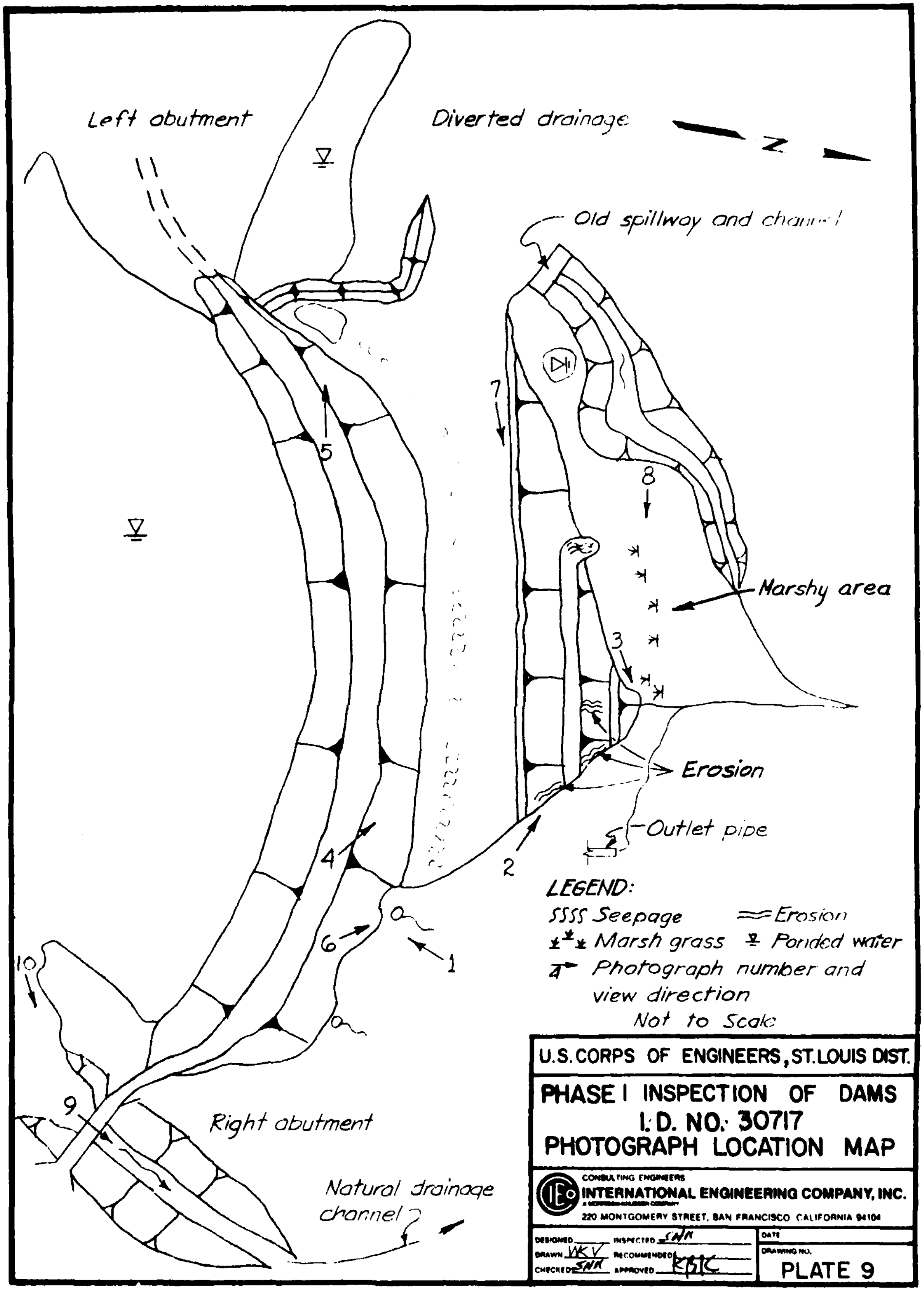
1 2



DAM I.D. NO. 30717
INDIAN CREEK
MINE, DAM
SPILLWAY PROFILE

Date of Survey 5/29/79

PLATE 8

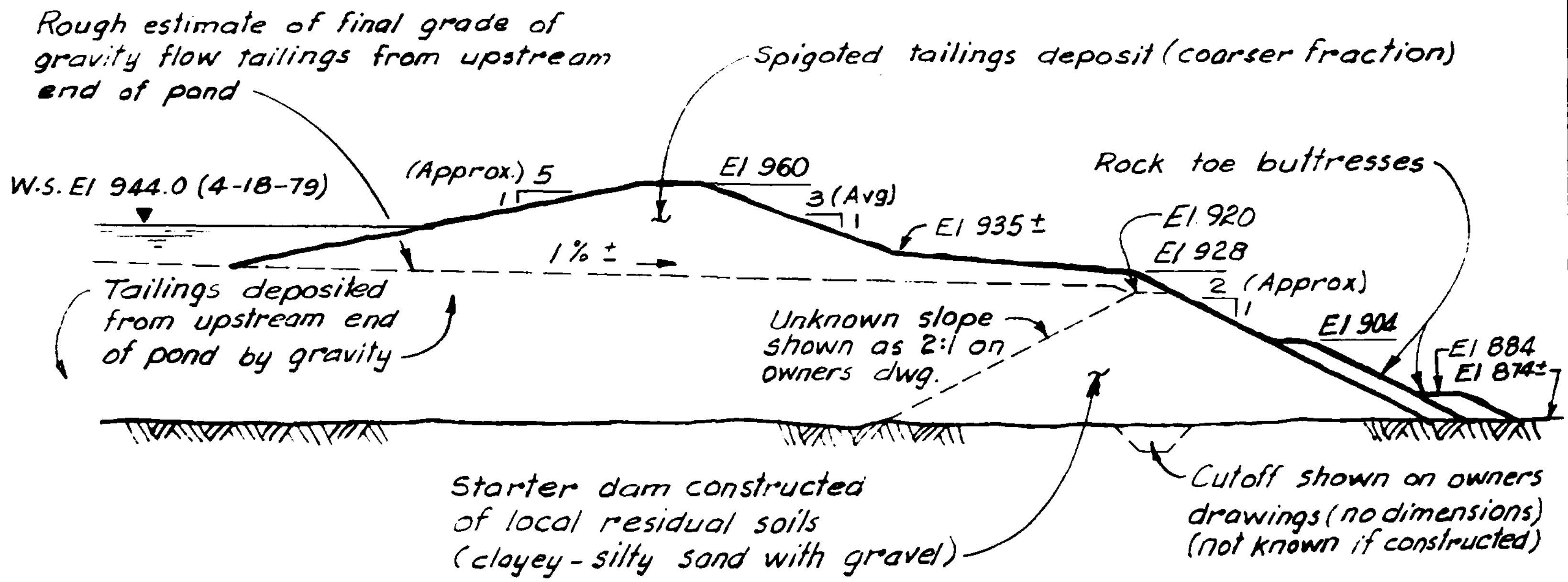


U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

PHASE I INSPECTION OF DAMS
I.D. NO. 30717
PHOTOGRAPH LOCATION MAP

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO CALIFORNIA 94104

DESIGNED ____ INSPECTED SNK
DRAWN WKV RECOMMENDED
CHECKED SNK APPROVED KBC
DATE
DRAWING NO.
PLATE 9



INTERPRETIVE MAXIMUM SECTION THRU DAM

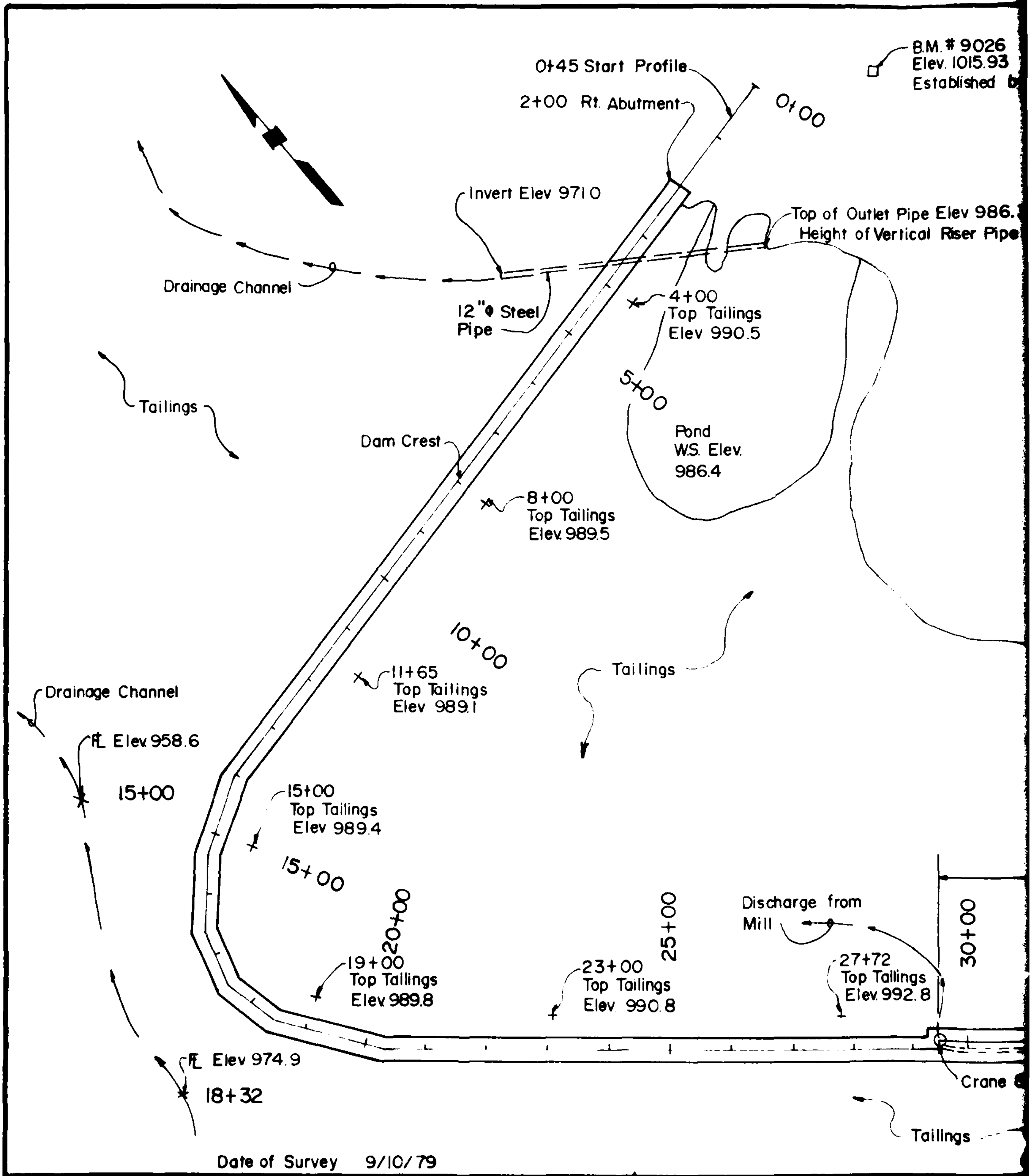
Not to scale

U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

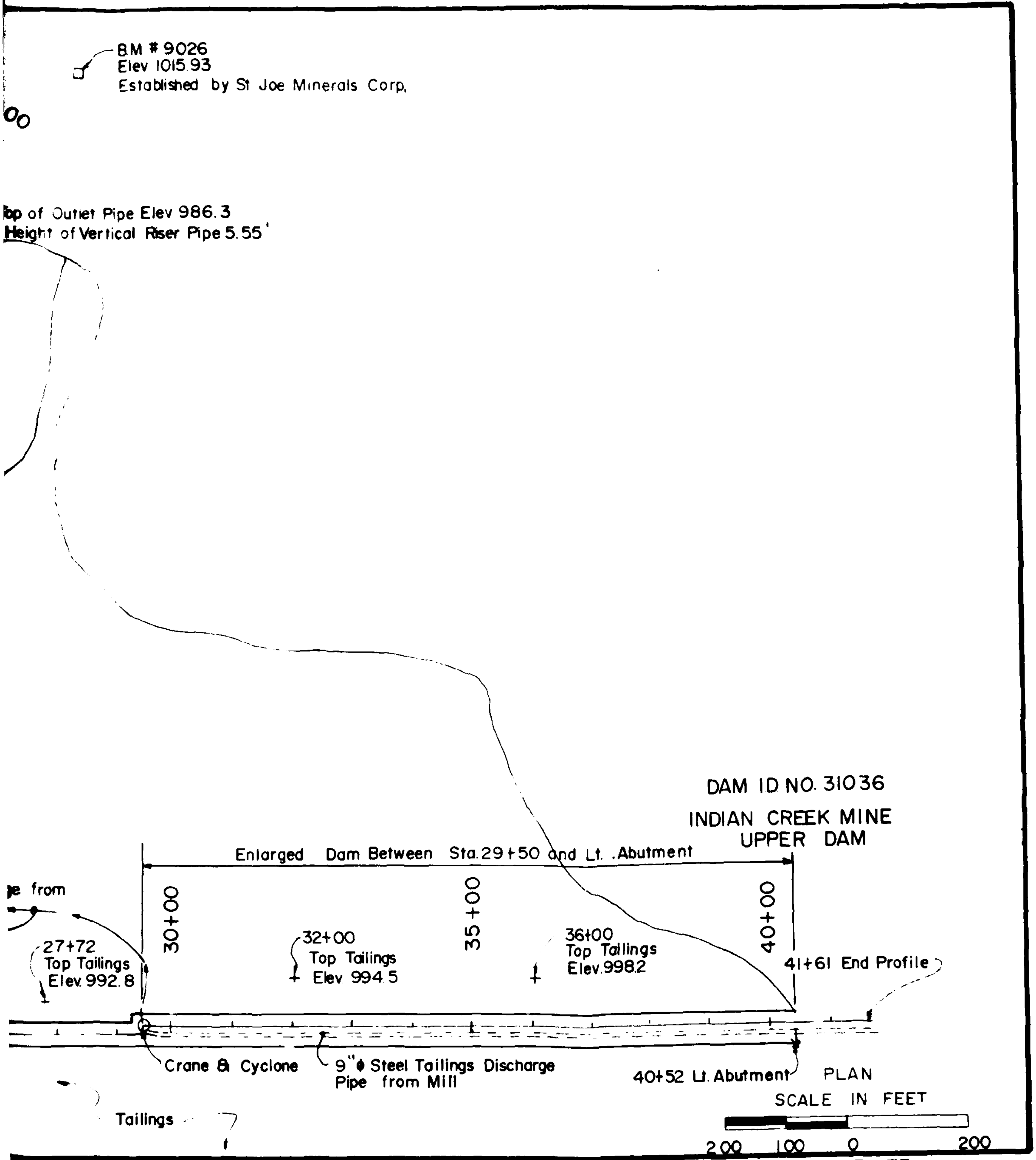
PHASE I INSPECTION OF DAMS
INDIAN CR. MINE DAM ID 30717
INTERPRETIVE MAXIMUM SECTION

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO CALIFORNIA 94104

DESIGNED ____ INSPECTED ____
DRAWN ____ RECOMMENDED ____
CHECKED ____ APPROVED ____
DATE
DRAWING NO.
PLATE 10



B.M. # 9026
Elev. 1015.93
Established
0+45 Start Profile
2+00 Rt. Abutment
0+00
Invert Elev 971.0
Top of Outlet Pipe Elev 986.
Height of Vertical Riser Pipe
Drainage Channel
12" Steel Pipe
4+00
Top Tailings
Elev 990.5
Tailings
5+00
Pond
W.S. Elev.
986.4
Dam Crest
8+00
Top Tailings
Elev. 989.5
10+00
Tailings
11+65
Top Tailings
Elev 989.1
Drainage Channel
FL Elev. 958.6
15+00
15+00
Top Tailings
Elev 989.4
15+00
20+00
25+00
Discharge from Mill
30+00
19+00
Top Tailings
Elev 989.8
23+00
Top Tailings
Elev 990.8
27+72
Top Tailings
Elev. 992.8
Crane
FL Elev 974.9
18+32
Tailings
Date of Survey 9/10/79

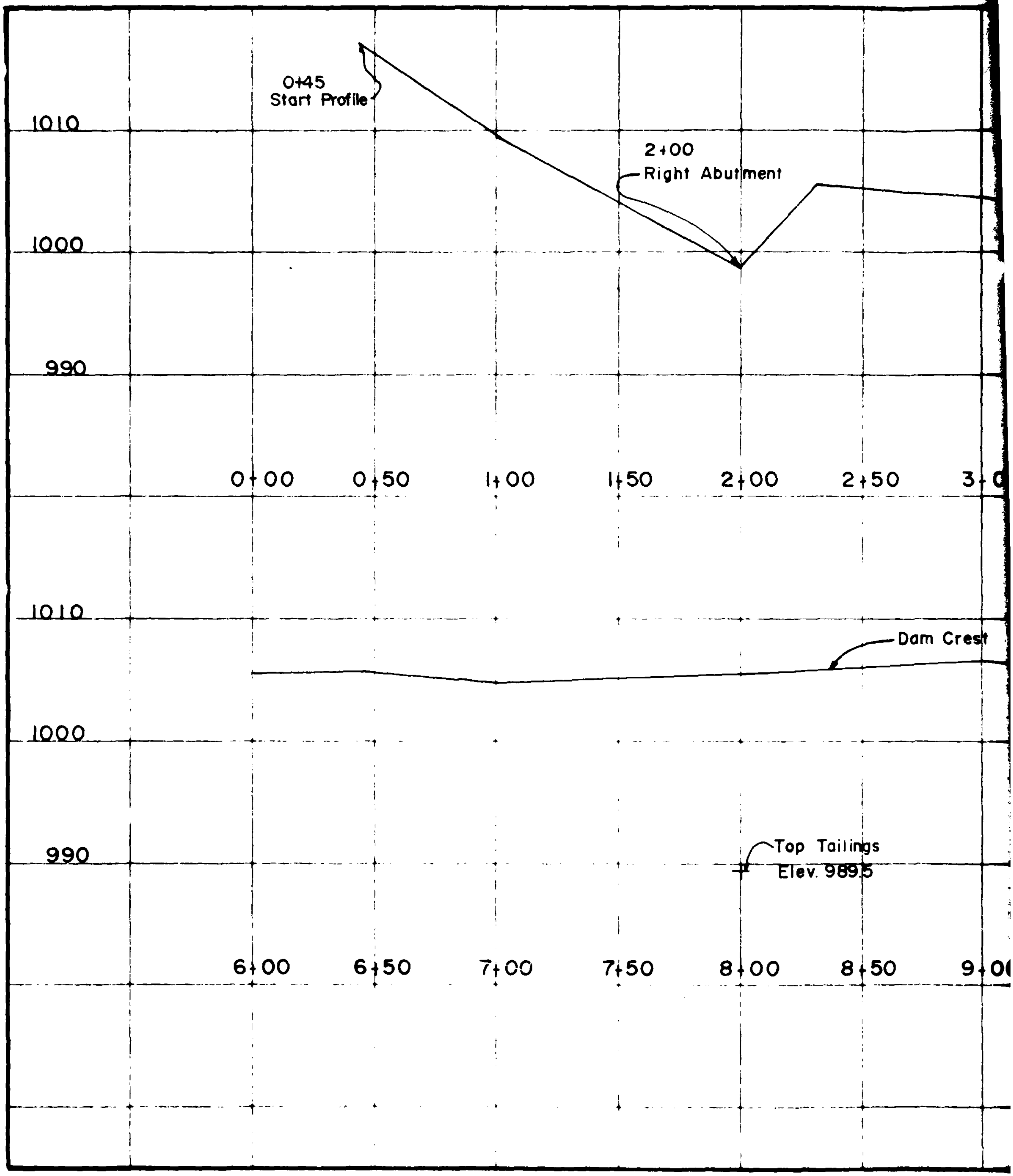


DAM ID NO. 31036

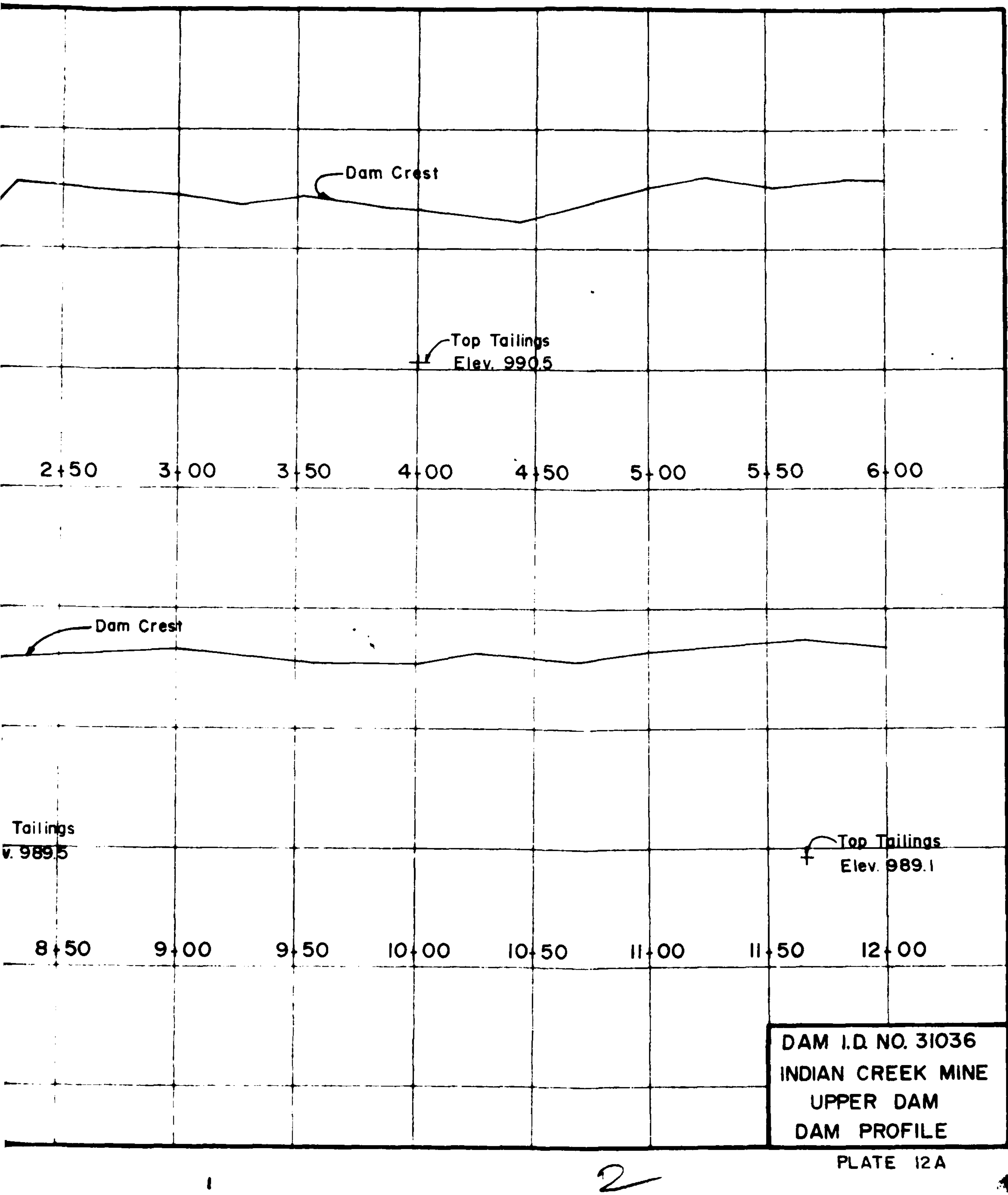
INDIAN CREEK MINE
UPPER DAM

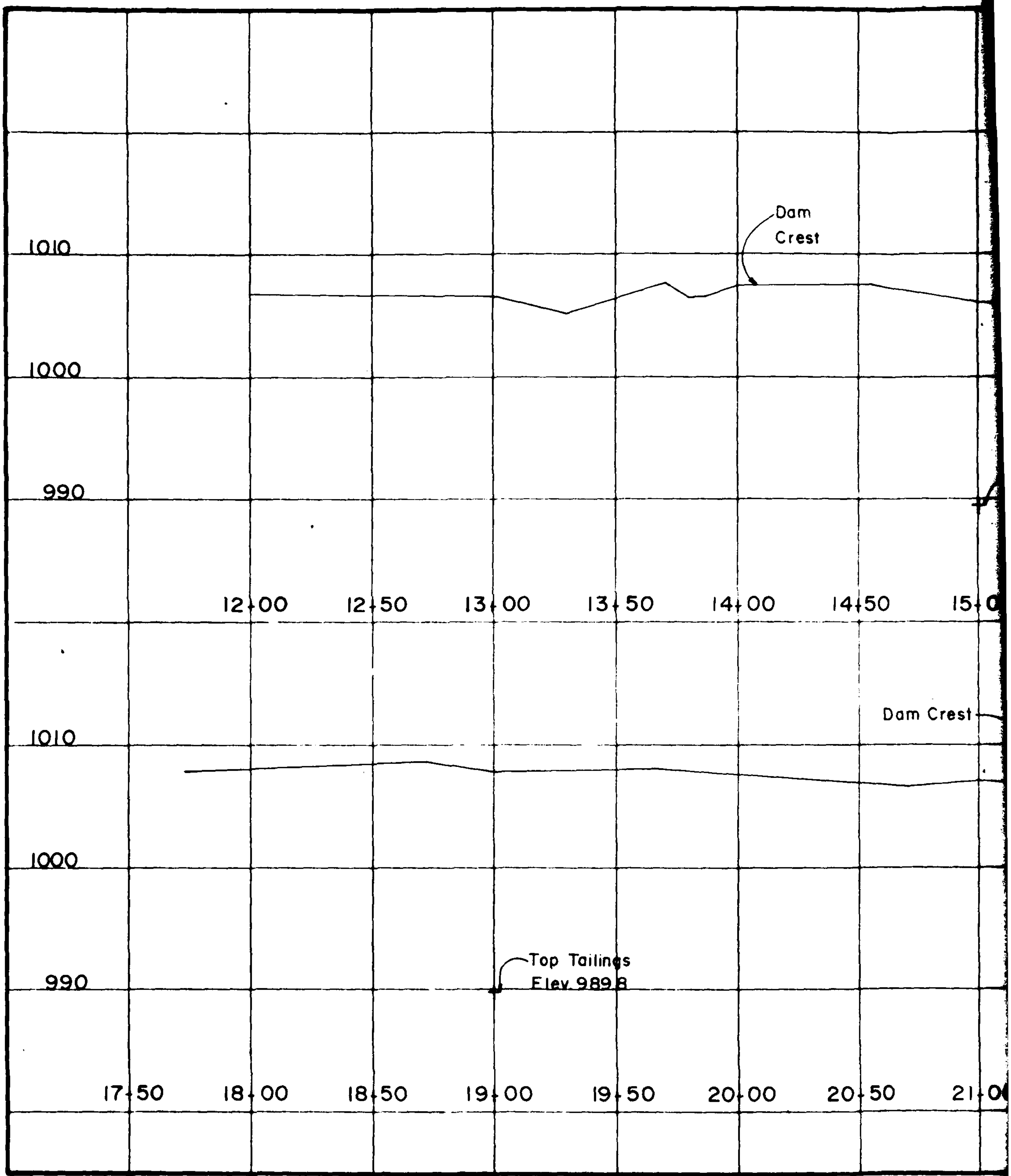
PLATE 11

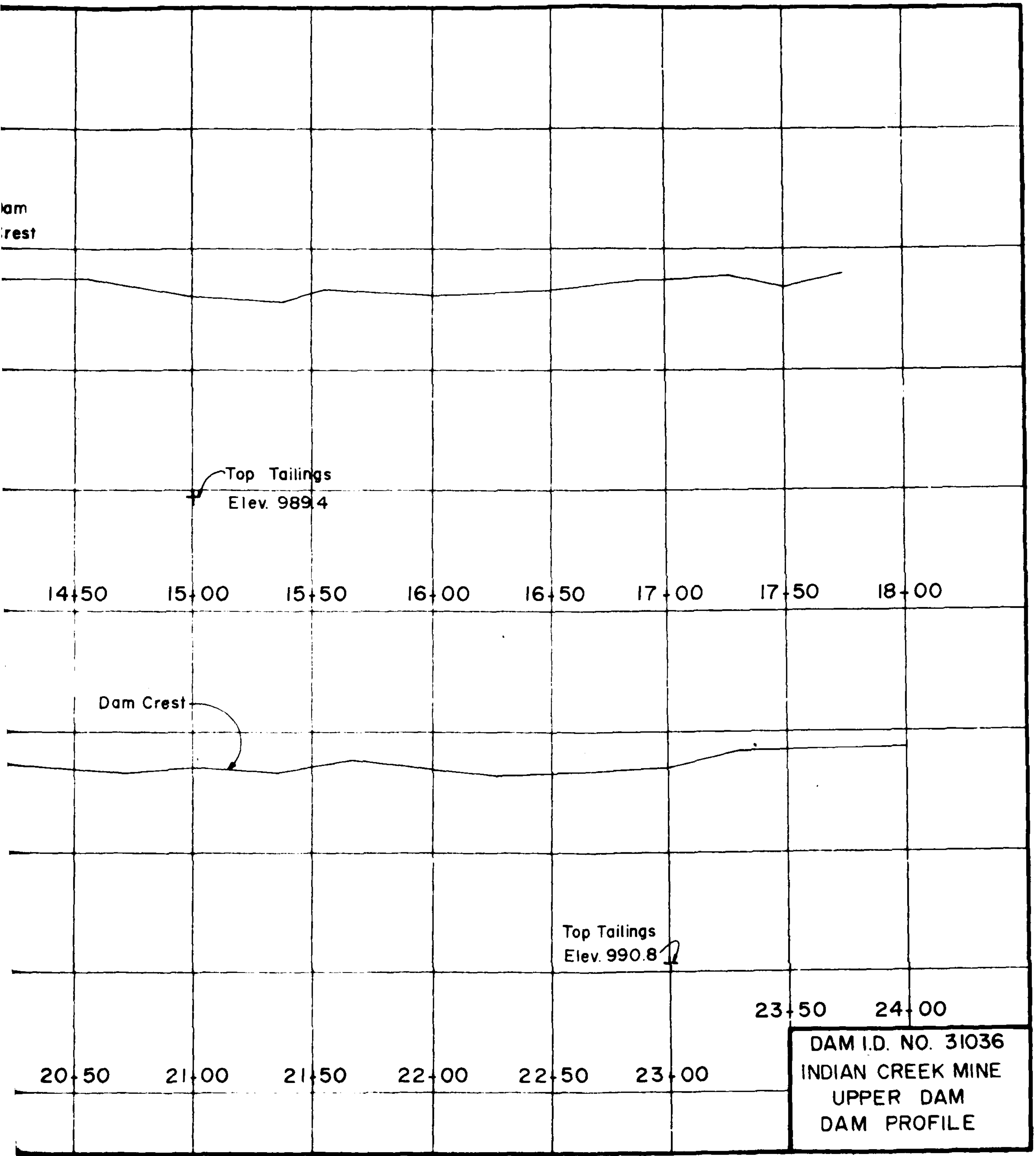
2



0+45
Start Profile
1010
2+00
Right Abutment
1000
990
0+00
0+50
1+00
1+50
2+00
2+50
1010
Dam Crest
1000
Top Tailings
Elev. 989.5
990
6+00
6+50
7+00
7+50
8+00
8+50

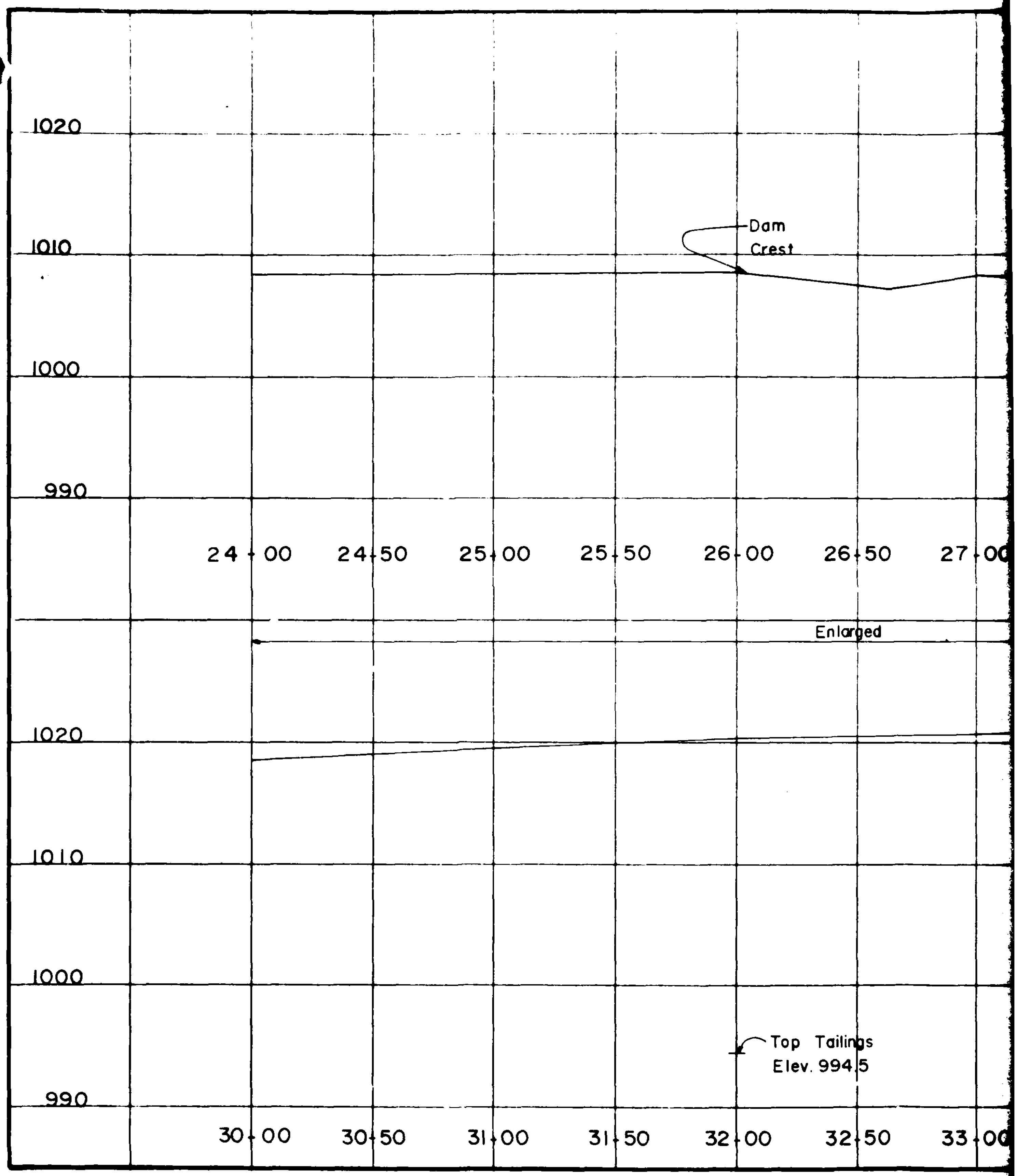

Dam Crest
Top Tailings
Elev. 990.5
2+50
3+00
3+50
4+00
4+50
5+00
5+50
6+00
Dam Crest
Tailings
v. 989.5
Top Tailings
Elev. 989.1
8+50
9+00
9+50
10+00
10+50
11+00
11+50
12+00
DAM I.D. NO. 31036
INDIAN CREEK MINE
UPPER DAM
DAM PROFILE
PLATE 12A
2


Dam
Crest
1010
1000
990
12+00
12+50
13+00
13+50
14+00
14+50
15+0
Dam Crest
1010
1000
Top Tailings
Elev. 989.8
990
17+50
18+00
18+50
19+00
19+50
20+00
20+50
21+0

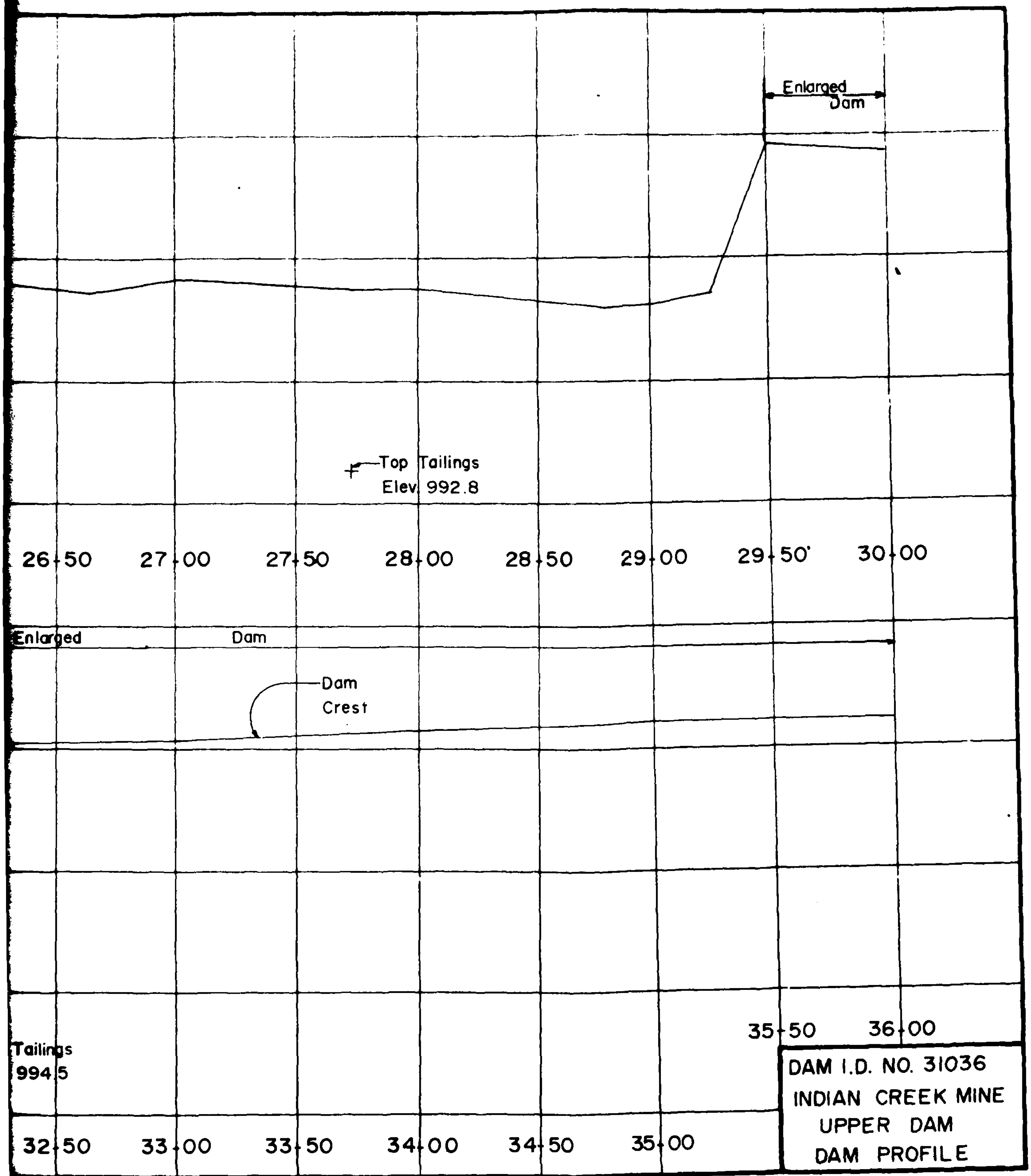


DAM I.D. NO. 31036
INDIAN CREEK MINE
UPPER DAM
DAM PROFILE

PLATE 12B



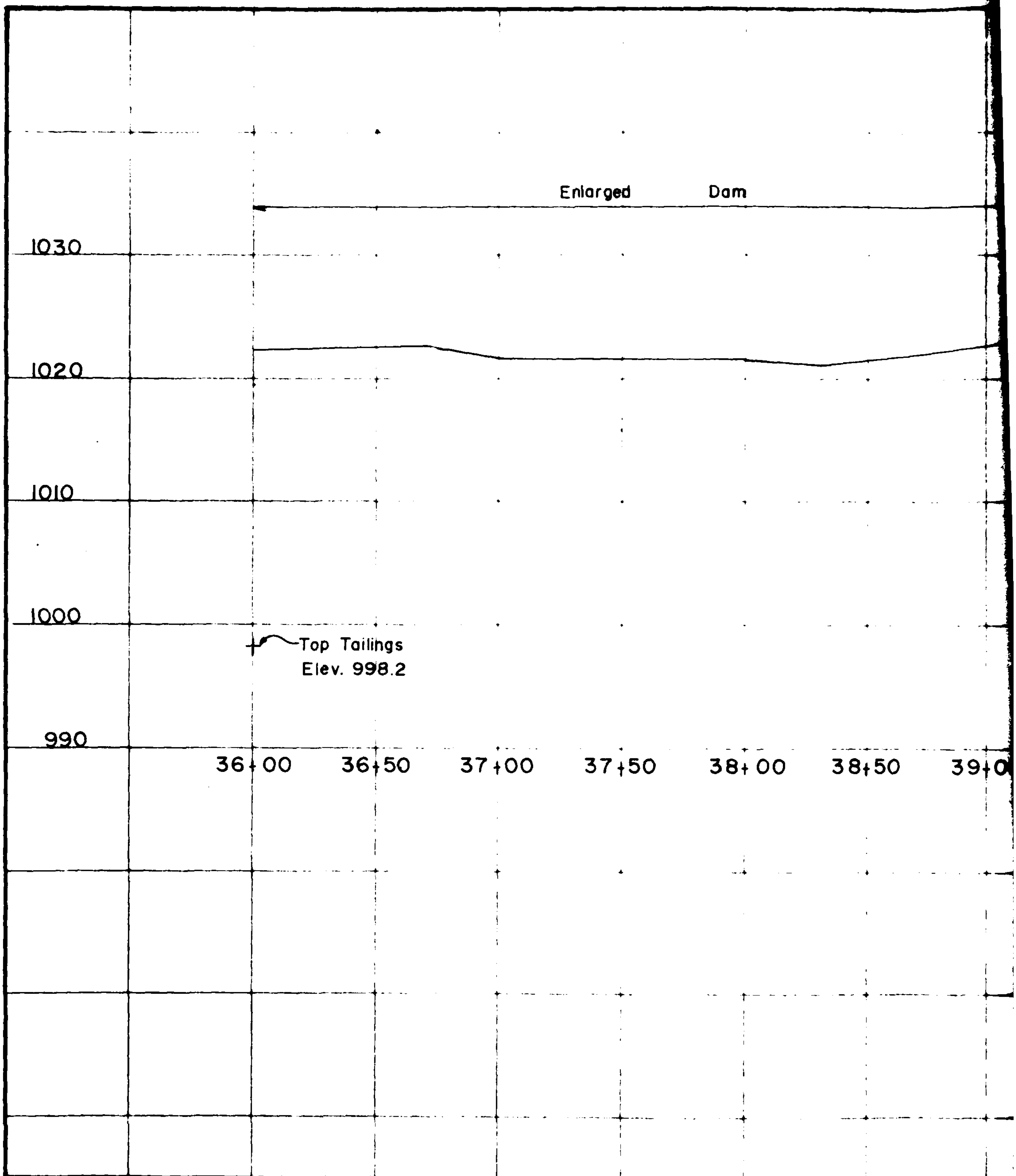
1020
1010
1000
990
Dam
Crest
24+00
24+50
25+00
25+50
26+00
26+50
27+00
Enlarged
1020
1010
1000
990
Top Tailings
Elev. 994.5
30+00
30+50
31+00
31+50
32+00
32+50
33+00

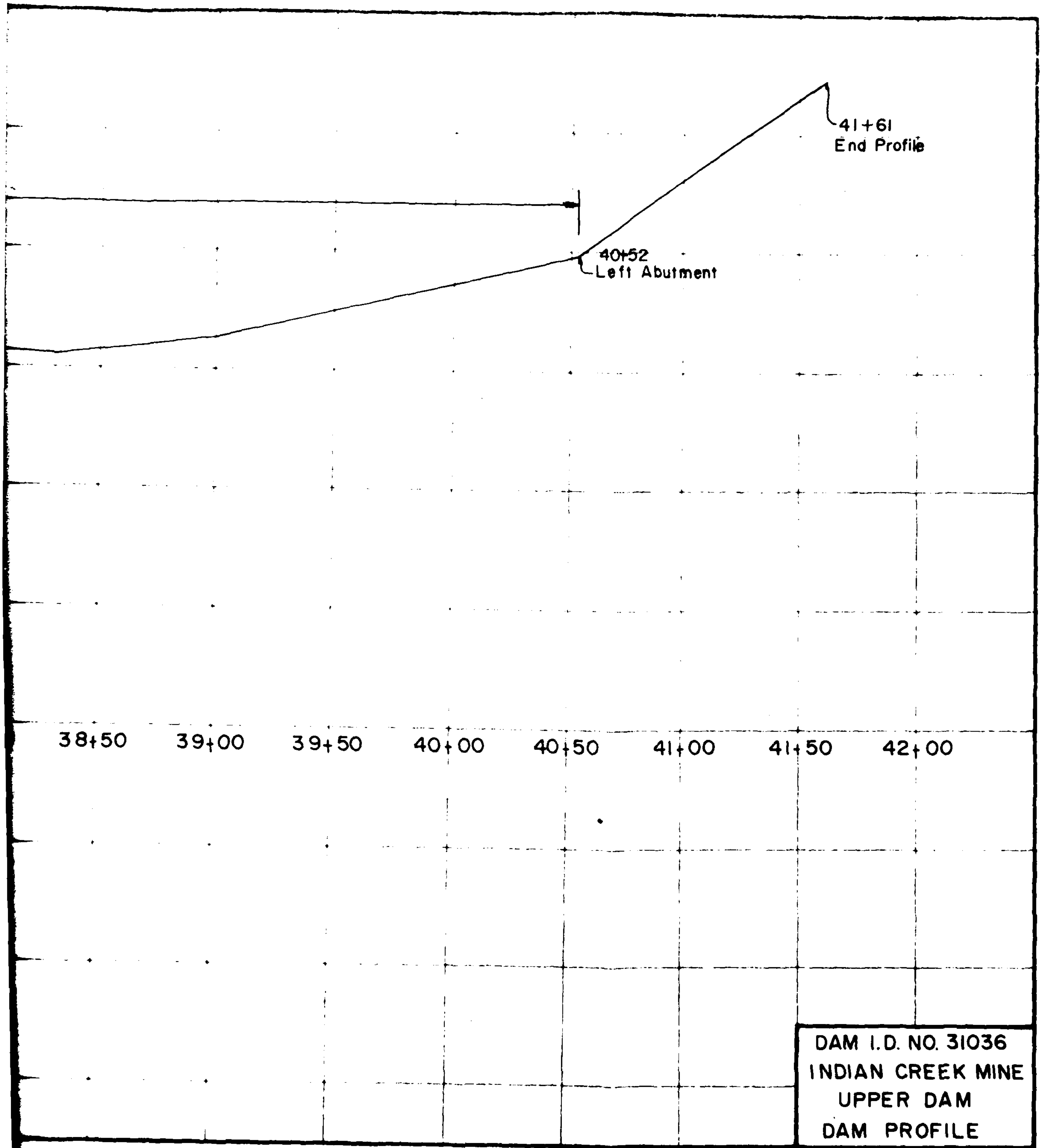


DAM I.D. NO. 31036
INDIAN CREEK MINE
UPPER DAM
DAM PROFILE

PLATE 12C

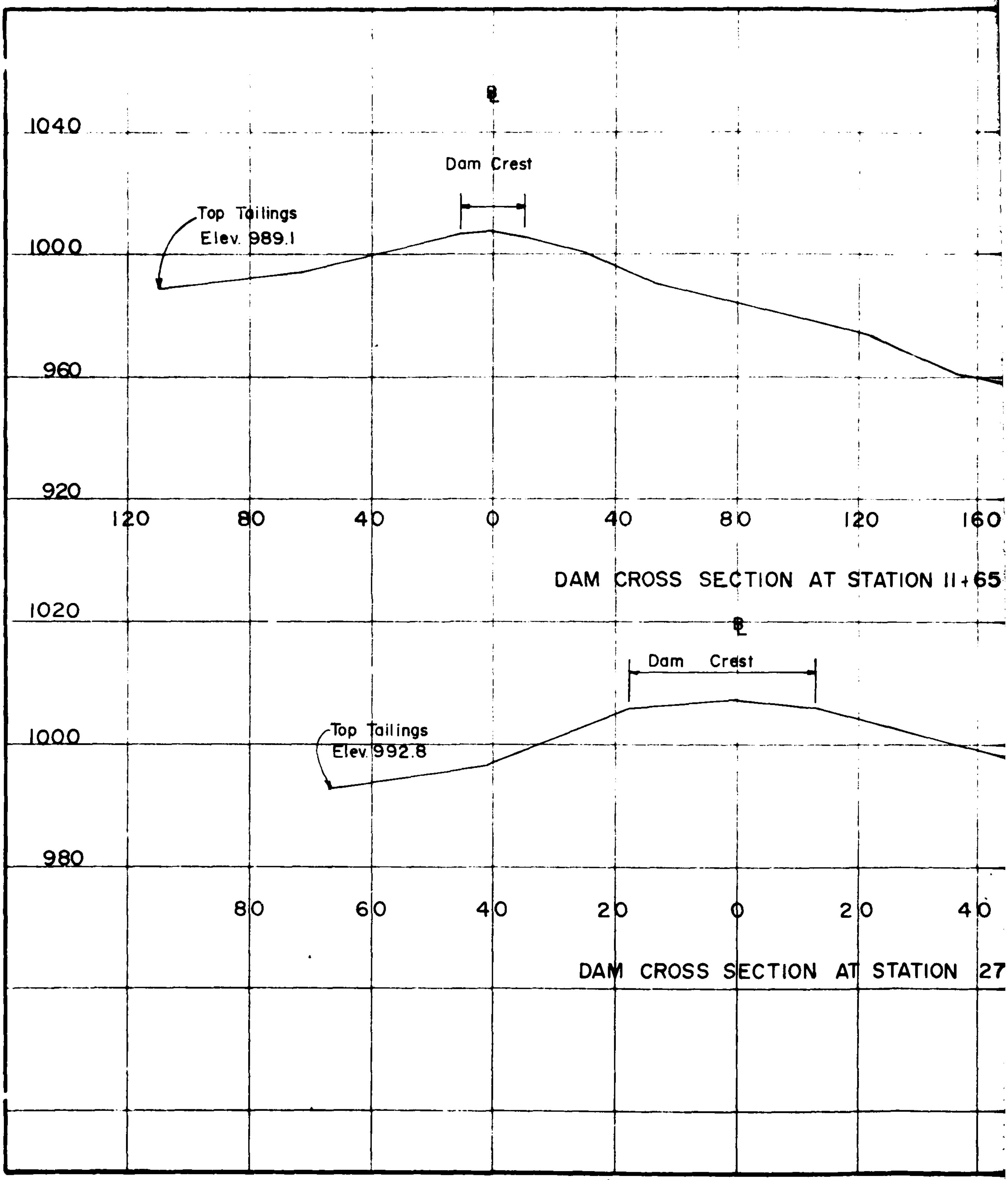
2


Enlarged Dam
1030
1020
1010
1000
990
Top Tailings
Elev. 998.2
36+00
36+50
37+00
37+50
38+00
38+50

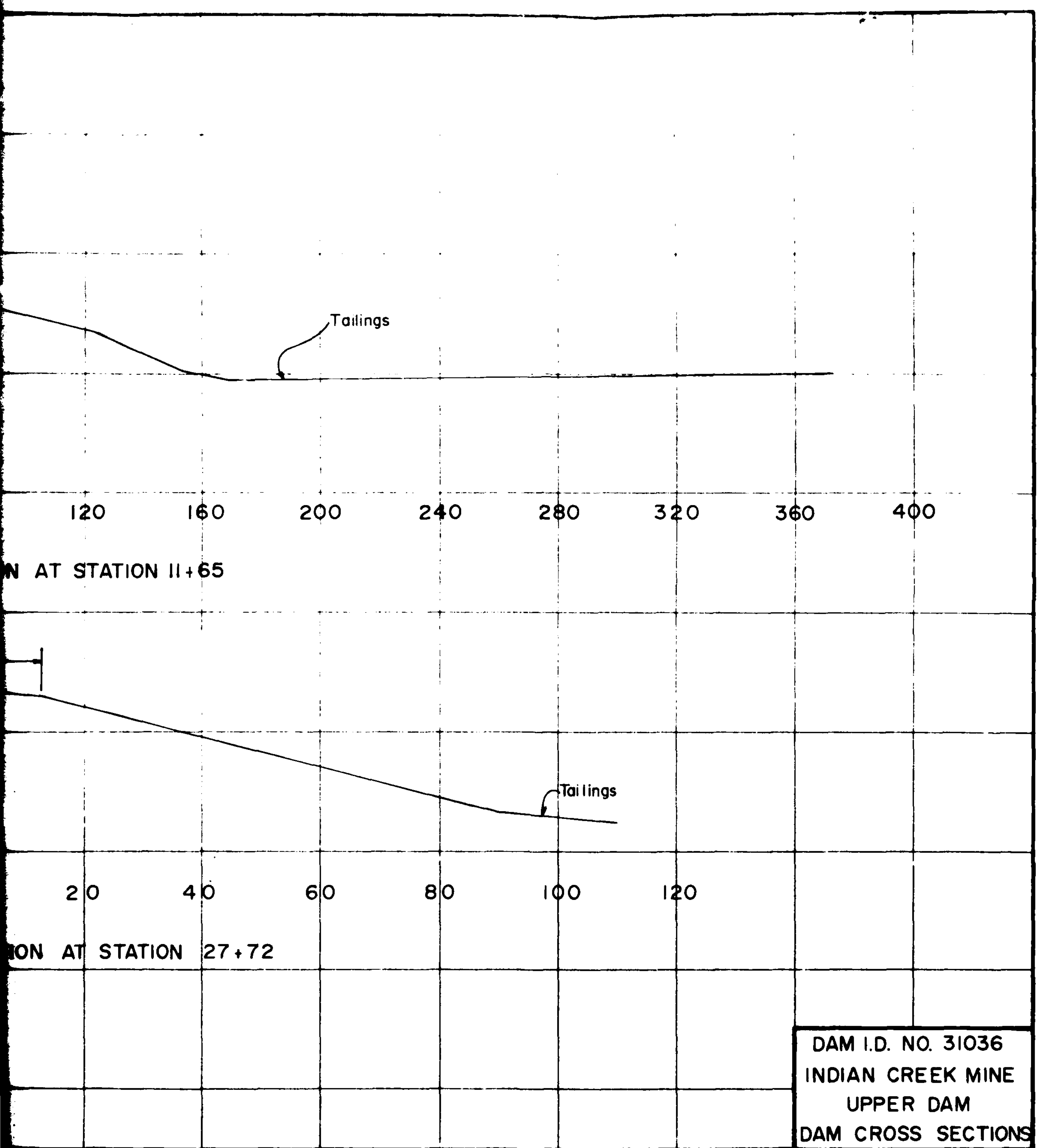


DAM I.D. NO. 31036
INDIAN CREEK MINE
UPPER DAM
DAM PROFILE

PLATE 12D



℄
1040
Dam Crest
Top Tailings
Elev. 989.1
1000
960
920
120
80
40
0
40
80
120
160
DAM CROSS SECTION AT STATION 11+65
1020
℄
Dam Crest
Top Tailings
Elev. 992.8
1000
980
80
60
40
20
0
20
40
DAM CROSS SECTION AT STATION 27

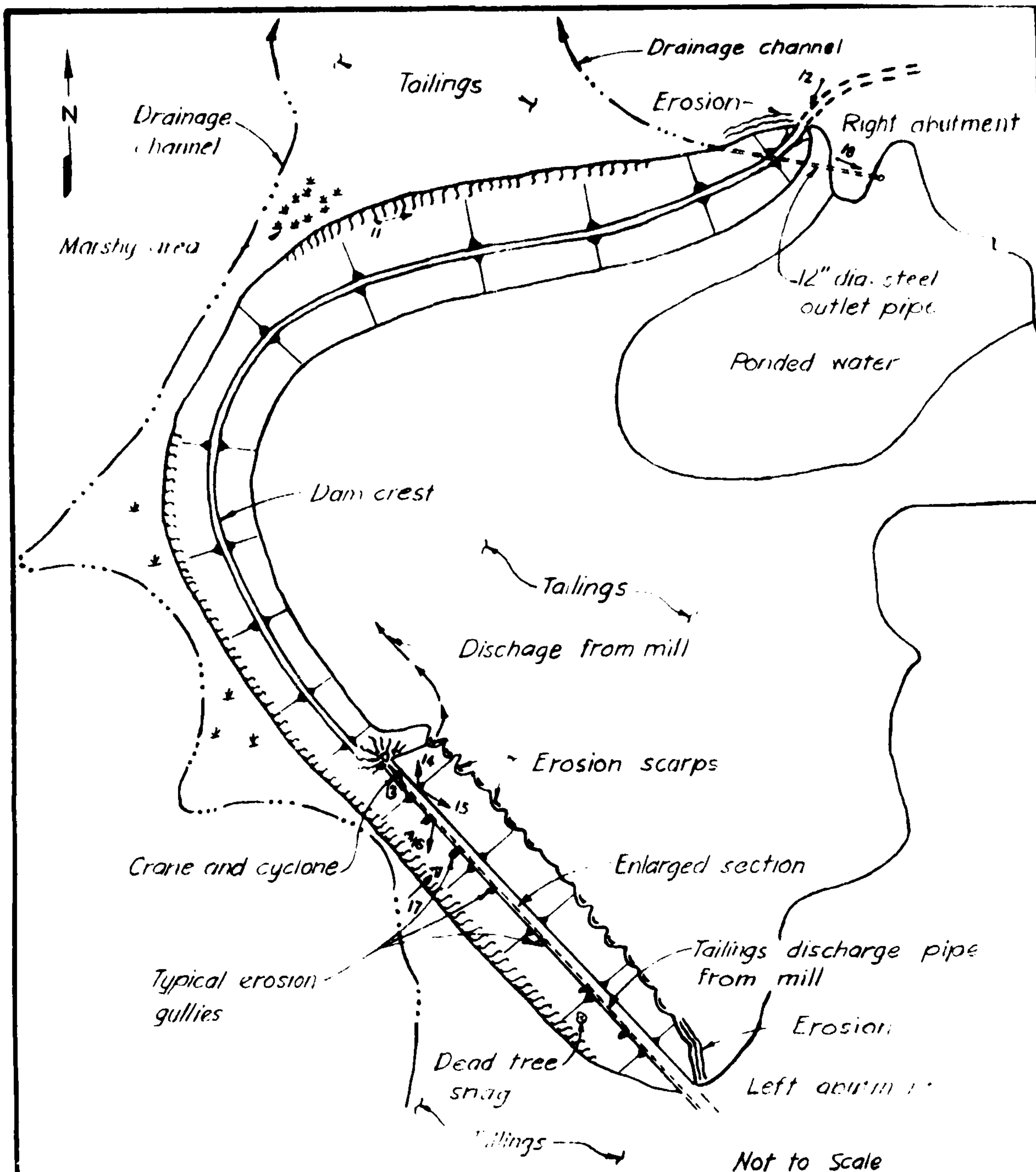


N AT STATION 11+65

ION AT STATION 27+72

DAM I.D. NO. 31036
INDIAN CREEK MINE
UPPER DAM
DAM CROSS SECTIONS

PLATE 13



LEGEND:

Seepage
Erosion gully
Erosion
Marsh grass
Photograph number and view direction

U.S. CORPS OF ENGINEERS ST. LOUIS DIST.

PHASE I INSPECTION OF DAMS
I.D. NO. 31036
PHOTOGRAPH LOCATION MAP

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
180 HOWARD STREET, SAN FRANCISCO, CALIFORNIA 94105

DESIGNED	INSPECTED	DATE
DRAWN AAC	RECOMMENDED	DRAWING NO.
CHECKED	APPROVED	PLATE 14

PHOTOGRAPH RECORD

INDIAN CREEK MINE LOWER DAM - I.D. NO. 30717

Photo No.	Description
1	Toe of tailings embankment near right abutment. Note seepage near toe and bedrock exposure.
2	View of dam toe along rock buttress at maximum section. Note erosion.
3	Toe of dam at maximum section. Note erosion and marshy ground.
4	View downstream from crest toward area behind left abutment. Note seepage wetting line, abandoned spigot line supports, and erosion rills at edge of the old dam.
5	Diverted drainage ponded behind left abutment. Note seepage through diversion dike.
6	Typical sloughing of embankment tailings from seepage.
7	Area below toe of starter dam. Note eroded materials and marshy ground.
8	View toward right abutment showing downstream slope and toe of starter dam. Note rock buttress, eroded materials and marshy ground at toe.
9	Spillway channel downstream from bridge. Note condition of slopes and materials.
10	Entrance to spillway channel.

PHOTOGRAPH RECORD

INDIAN CREEK MINE UPPER DAM - I.D. NO. 31036

Photo No.	Description
11	Downstream toe of north leg of dam. Wetting and seepage line, and soft, saturated tailings foundation are apparent in the photograph.
12	Dam crest low point at right abutment. The enlarged area along the south leg of the dam and erosion at the toe of the interior slope due to tailings discharge are evident in the background.
13	Cyclone operation on dam crest near Station 29+00. Fine lead tailings discharge into impoundment is through the pipe suspended to the right of the crane.
14	Discharge of fine lead tailings slurry into impoundment near Station 29+00.
15	Toe of exterior slope of dam at enlarged area along south leg showing seepage and erosion. The drainage channel along the west side of the dam is evident in the background.
16	Upstream or interior slope of dam at enlarged area along south leg. Surface erosion and erosion along the toe due to tailings discharge are apparent in the photograph.
17	Downstream face of dam along south leg showing typical erosion gully at crest at location of tailings pipeline joint, and piping, sloughing, and erosion due to drainage of the tailings deposit.
18	Top of vertical riser outlet pipe near right abutment.

1

2


3

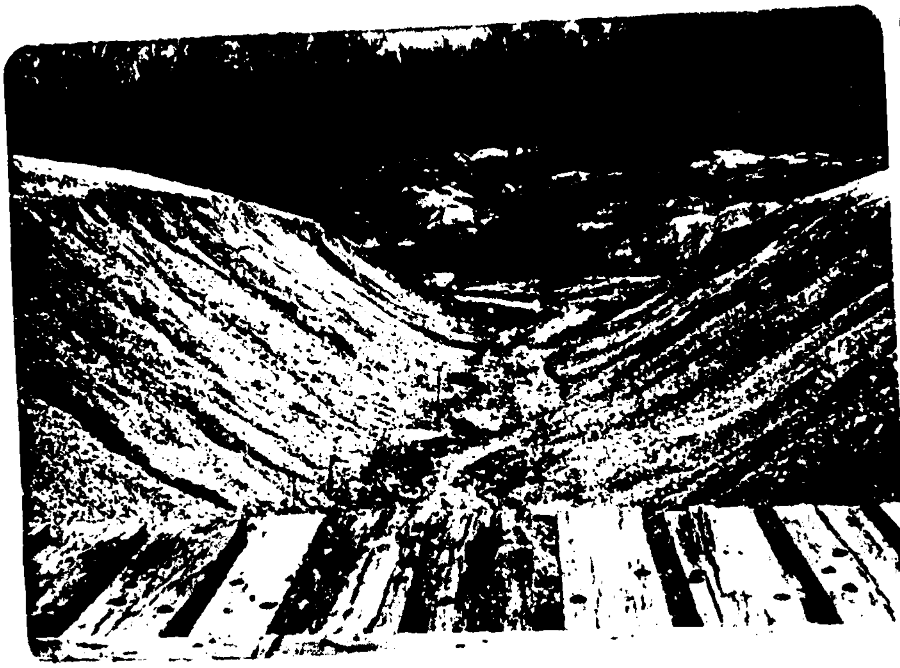

4

5

6

7

8



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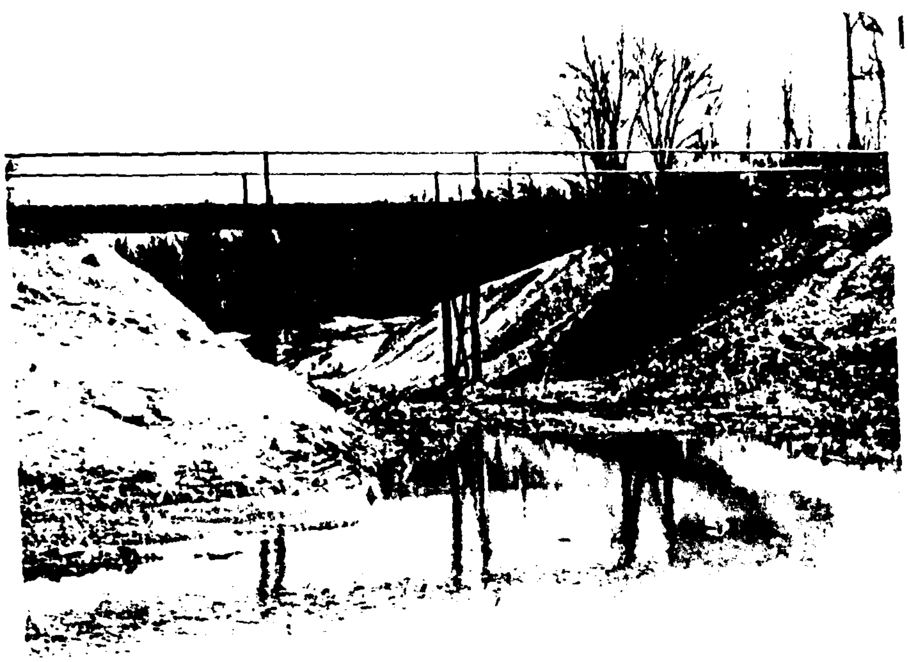
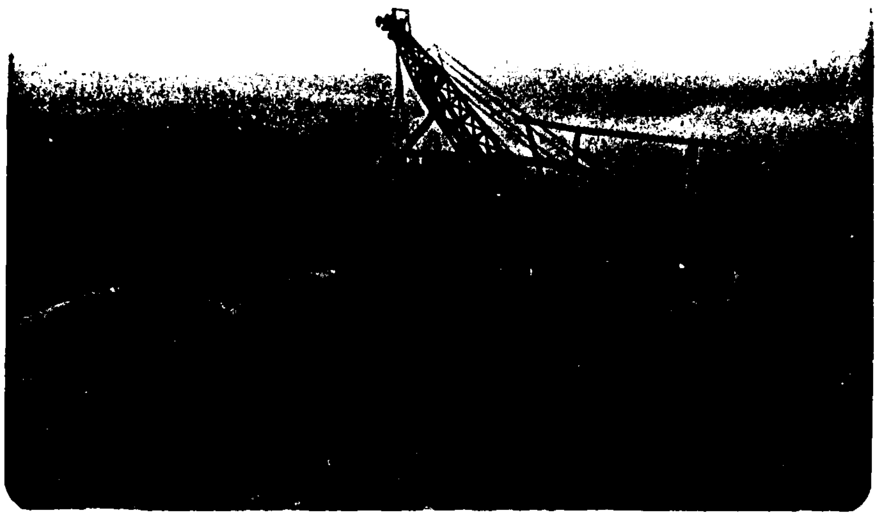


10

11

12

13



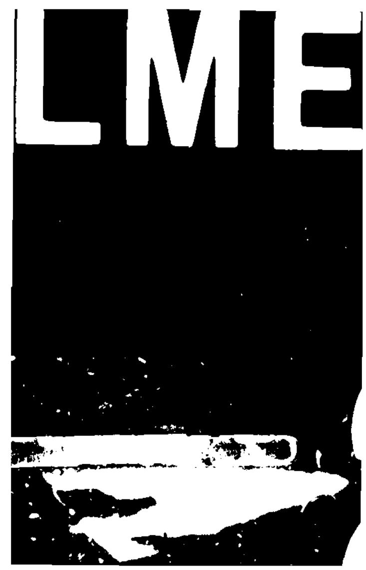
14

15

16

17

18


LME